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THE WILD SHEEP OF THE OLD WORLD AND THEIR DISTRIBUTION

[After Dr. N. Severtzov and Prof. N. Nassonov]

BY PROF. PETER P. SUSHKIN, MEM. RUSSIAN ACAD. SCI.

The wild sheep (genus *Ovis*) form a very interesting group, difficult and complicated in its classification, and extremely attractive in the zoogeographical problems it presents. I here give a short review of the studies of this group by two Russian zoologists, the late Dr. N. Severtzov, famous explorer of the Russian Turkestan, and Prof. N. Nassonov, member of the Russian Academy of Sciences, with the addition of some remarks of my own concerning the history of the migrations of this group.

The papers of Dr. N. Severtzov on wild sheep were published as long ago as 1873. One of them is his *Horizontal and vertical distribution of Turkestan animals;*[1] another is a special monograph on the wild sheep.[2] Both were published in Russian. The ornithological part of the former has been translated into the west European languages, but the part

[1] Вертикальное и горизонтальное распредѣленіе туркестанскихъ животныхъ —Извѣстія Общества Любителей Естествознаніе, Антрополоагіи и Эмнографіи. T. VIII. 1873. Москва 4°.—[Vertical and horizontal distribution of Turkestan animals.—Memoirs (Izvestia) of the Society of Amateurs of Natural History, Anthropology, and Ethnography, vol. 8, 1873, Moscow, 4to].

[2] Аркары (горные бараны).—Прироба м. I. Москва. 1873. 8°. [Arkars or wild sheep.—Priroda, vol. 1. Moscow. 1873. 8vo.]

Priroda was an annual magazine of natural history published in Moscow in the seventies. Not to be confounded with the monthly periodical of same name published in Moscow since 1910.

concerning the mammals seems to have never been completely translated; the other paper has never been translated at all; and neither paper has ever been taken into account to its full extent. Only the descriptions of new forms described by Severtzov have been quoted and rather misinterpreted, and his ideas on the zoogeography of the sheep, some of which have never lost their value, seem to have been completely overlooked.

Severtzov subdivided the wild sheep into two genera, *Musimon* and *Ovis* s. str. Of the species, Severtzov adopts[3] for *Musimon* the following ones: *musimon* Schreb., *cyprius* Blas., *anatolicus* Val., *orientalis* Gmel., *vignei* Blyth, *cycloceros* Blyth, *areal* Brandt (and also *nahoor* and *burrhel*, which were separated later as *Pseudois*); and for *Ovis: argali* Pallas (=*ammon* Linn.), with var. *mongolica* nov. (=*daurica* nov.) and *altaica* nov., *hodgsoni* Blyth, *blythi* nov., *polii* Blyth, *karelini* nov., *nigrimontana* nov., *heinsii* nov., ? *collium* nov.,[4] *montana* auct. (=*canadensis* Shaw), *nivicola* Eschsch., ? *borealis* nov.[4] The geographic ranges of these two genera, or groups, are separated by the line which runs "across the western ranges of the Pamir System and along the southern foot of the Karakorum Range."

The distribution of the *Musimon* group is known to a large extent through literature, and some of the forms concerned were familiar to Severtzov only by descriptions. But Severtzov was the first to lay a foundation for the zoogeography of his group *Ovis* s. str., many forms of which he has studied also in the field. In this group, Severtzov accepts the following zoogeographical divisions which correspond also to genetical relations: (1) Tian-Shan and Pamir division,—*polii*, *karelini*, *nigrimontana*, *heinsii;* (2) Altai and Tangut division (which occupies "the northern part and eastern border of High-Asia, that is, the whole Altai System, northern Gobi, Tangutian System, and penetrates [from the east] into the southern Tibet"),—*hodgsoni*, *blythi*, *argali*, and *altaica;* (3) American and Siberian division,—*montana*, *nivicola*, and ? *borealis*.[5] According to Severtzov's conception, "Tibetan forms, *hodgsoni* and *blythi*, differ from the American *montana* less than from the geographically near *polii* which, moreover, lives in identical environment." During the glacial period the sheep were driven south, and in the post-glacial time migrated north, spread west along the border of the Siberian woodland, and colonized Turkestan, spreading

[3] Everywhere nomenclature adopted by Severtzov is preserved.
[4] Considered doubtful by Severtzov.
[5] Considered doubtful by Severtzov.

from the Altai. Turkestanian forms Severtzov considers as the latest, and derivatives of his *argali*. Of the American and Siberian group, Severtzov says that on the continent of Asia "it is divided from the Mongolian *argali* by Siberian woodland, north of which, as well as in Kamchatka, lives the Arctic or snow sheep, *O. nivicola*, barely distinct from the American *O. montana*." Probably, "*Ovis* migrated from Asia to America before it split into recent species." "During this migration to America, the western part of this continent had a connection with Asia but may have been separated from the eastern part and from South America where the sheep did not penetrate." During the glacial period, the sheep "like many other animals, were driven south on both continents." In the post-glacial, "the sheep spread again to the north and the American *montana* sent emigrants to Kamchatka and northern Siberia where they changed into *O. nivicola* and *O. borealis*."[6] In another paper,[7] which was written later, Severtzov exposes a somewhat different conception of the process: "The glacial period must have driven them gradually to the south, and then the northernmost form, *nivicola*, must have occupied the whole land-bridge, and have divided the area of *O. montana* from that of *O. argali;* then, as the land-bridge was broken, *O. nivicola* became separated geographically from *O. montana;* later on, after the glacial period, *O. nivicola* spread from Kamchatka to other parts of northern Siberia."

It is to be understood, when considering these ideas and statements, that they date back a full half-century, and our museum materials, knowledge of local forms and their distribution, and our geological and paleogeographical information have since increased enormously. In particular it may be noted that Severtzov in some cases admits too rapid evolution of species; the whole Turkestanian group of sheep he allows to have been evolved since the end of glacial time. Nevertheless the outlines of the relations of the High-Asian sheep are to be credited to Severtzov. His ideas of the relations of American and North Siberian sheep have a permanent value and Professor Nassonov, who studied this group much later, supports completely this theory of double migration.

Prof. N. Nassonov, during his activity as Director of the Zoological Museum of the Russian Academy of Sciences, contributed much toward increasing its collection of wild sheep which is now certainly the richest in the Old World forms, and consists of 327 skins, 502 skulls with horns,

[6] Vertical and horizontal distribution of Turkestan animals.

[7] Monograph of the wild sheep.

62 pairs of horns, and 90 skeletons. This material, and also Professor Nassonov's studies during his visits to the British Museum, the Museum für Naturkunde in Berlin, and the Museum of the Moscow University, form the basis of his monograph, "Geographical distribution of the wild sheep of Old World."[8] This monograph was preceded by ten smaller articles by the same author dealing with separate questions of the classification of this group, published from 1909 to 1922.[9] It deals mainly with the questions of zoogeography. Detailed systematical description forms the subject of a special paper which has also been presented to the Academy, but is still waiting for publication.

Of the Old World sheep, Professor Nassonov accepts the following groups, species, and subspecies:

Gen. *Ovis*
Sect. Mufloniformes
O. ophion Blyth.
ophion Blyth.—Cyprus; (?) southern slopes of Taurus.
anatolica Valenciennes.—Cilician Taurus; Bulgar Dagh; Ala Dagh; and probably Anti-Taurus.
armeniana Nassonov.—Alaghez; Djulfa; Ararat; Bayazid.
O. gmelini Blyth.
gmelini Blyth.—Erzerum (?).[10]
isphahanica Nassonov.—Mountains of southwestern Persia: near Ispahan; Range Pushti-Kuh.
erskinei Lydekker.—Elburz Mountains; Mount Savelan.
urmiana Guenther.—Islet Koiun-Daghy in the Urmi Lake (introduced ?); Mountains Kara-Dagh; north of Travriz (?).
O. laristanica Nassonov.—Laristan (southern Persia) and (?) probably to Persian Baluchistan.
O. orientalis Gmelin.
orientalis Gmelin.—Eastern part of Elburz Mountains, Persia.
dolgopolovi Nassonov.—Mountains of Astrabad Province, Persia, and east to Afghanistan.
cycloceros Hutton (= *varenzovi* Satunin).—Great Balkan (Transcaspia), Kopet Dagh, and Paropamir, east to Peshawar and Kandahar.

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[8] Географическое распространение диких ъаранов старого света (Distribution géografique des moutons sauvages du monde ancien) Петрограб.—Petrograd, 1923. Published by the Russian Academy of Sciences, 8vo, 18 plates (3 colored), 6 text figs., and a map.

The paper was presented to the Academy in 1918-1919 but, owing to the conditions of printing, was published, with some additions, only as recently as about the autumn of 1923.

[9] Enumerated in the list of literature of Nassonov's monograph.

[10] Reputed *terra typica*; no wild sheep have been found by later explorers near Erzerum and no specimens exactly similar to the type have been found elsewhere.

arcar Eversmann.—Ust-Urt, and Mangyshlak Peninsula.

O. vignei Blyth.

vignei Blyth.—Ranges along the upper Indus as far south as Gilgit, north to Vakhan (southwestern Pamir).

punjabiensis Lydekker.—Salt Range, Punjab; perhaps also Soliman Range.

(?) *blanfordi* Hume.—Kelat, Baluchistan.

bochariensis Nassonov.—Upper Zerafshan to Piandj.

O. musimon (Pallas).—Corsica and Sardinia.

Sect. Argaliformes

O. polii Blyth.

severtzovi Nassonov.—Range Nuratau or Karatau, southern part of Desert Kizyl-Kum.[11]

nigrimontana Severtzov.—Range Karatau, north of Syr Daria.[12]

karelini Severtzov.—Trans-Ilian or Za-Iliiskii Alatau; upper Naryn (sources of Syr Daria); and around Issik-kul.

littledalei Lydekker.—Dzungarian Alatau, west to the River Chilik (tributary of Ili), east along upper Ili and Yulduss; perhaps as far as Hami.

collium Severtzov.—Tarbagatai and hills of the Kirghiz Steppe north of Lake Balkhash, west into the western part of Akmolinsk Province.

polii Blyth.—Pamir and Alai, south to Hunza, north to Khan-tengri.

heinsii Severtzov.—Near Tokmak, Turkestan (? extinct).

(?) *sairensis* Lydekker.[13]—"Saiar, Sair or Jair Mountains"; also "Semitau," "86° E. long., 47°N. lat."; "and 84° E. long., 46° N. lat." Probably Saur (or eastern Tarbagatai); Semiz-tau; and Jair.

O. ammon Linné.

hodgsoni Blyth.—Himalaya and southwestern Tibet, east to Sikkim, (?) north to Kuen-lun.

dalai-lamae Przevalski.—Altyn-Tagh, Toguz-Davan, and (?) Russkii Range, south to Przevalski's Range.

jubata Peters (= *darwini* Przevalski).—Columbus Range and Tangla to the mountains of eastern Mongolia north of Pekin.

kozlovi Nassonov.—Hills Yabarai, southern Gobi.

mongolica Severtzov (= *daurica* Severtzov).—Northwestern Mongolia from Mongolian Altai to Tannu-ola; Transbaikalia (extinct).

przevalskii Nassonov.—Sailüghem Range.[14]

ammon Linné.[15]—Russan Altai (extinct in its western parts).

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[11] Not to be confounded with another Karatau, habitat of *nigrimontana*, which lies much farther north.

[12] Western continuation of the range Alexandrovskii.

[13] Form doubtful geographically and systematically.

[14] Range bordering the highland of the Russian Altai from southeast and east; its Mongolian slope belongs to the basin of Kobdo River and of the lake Uriug-nor. On the map, the number XXVII by which this race is designated, is set wrongly *north* of the Sayan Range, where *no* sheep occur.

[15] = *argali* Pall. = *altaica* Severtzov.

O. nivicola Eschscholtz.
nivicola Eschscholtz (= *storcki* Allen).—Kamchatka.
alleni Matschie.—Taiganos Peninsula[16]; Kolyma Range; and Djugdjura Range.
lydekkeri Kowarzik.—Northeastern part of Verkhoyansk Range.
borealis Severtzov.—Syverma Range.[17]
potanini Nassonov.—Southwestern part of Stanovoi Range.

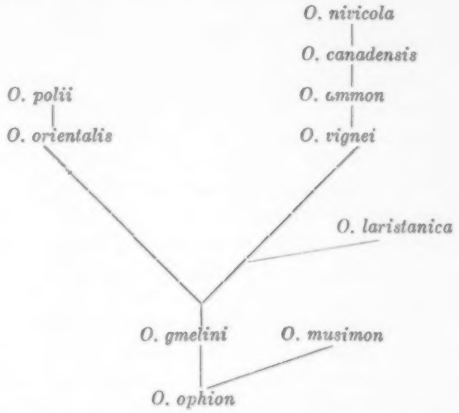
Of the American forms, Professor Nassonov refers to *O. nivicola* the subspecies *dalli, kenaiensis, fannini, stonei,* and *cowani.* The remainder of the American sheep,—*canadensis, auduboni, californica, nelsoni, sierrae, cremnobates, mexicana,* and *gaillardi,* he refers to *O. canadensis.* It is emphasized that *nivicola* and *canadensis* are specifically distinct, the latter being the nearest of the two to the sheep of High-Asia.

Some points concerning classification and distribution, Professor Nassonov considers as yet not settled. The type of *O. gmelini gmelini* remains unique, and no sheep have been found by later explorers in its reputed *terra typica.* The true home of *O. g. urmiana* is unknown, as is also the exact locality of *O. laristanica.* There is some doubt as to the identity of Kopet Dagh and Afghanistan specimens of *cycloceros.* Of the High-Asian argaliform sheep, the form of easternmost Tian-Shan (near Hami) is unknown; and *O. polii sairensis* is doubtful, this name covering perhaps two different races. The races which inhabit the Alashan Range, mountains of southeastern Mongolia (Sumakhada and Khara-narin-ula), eastern Nan-shan, and the mountains south of Tangla are uncertain. Of the Siberian sheep, the subspecies which inhabits the Chukchi Peninsula is still unknown. The ranges along the coast of Okhotsk Sea may be inhabited by several races allied to *alleni,* but different from it. Somewhat uncertain in its characters and distribution, and one of the most interesting forms, is *borealis.* In my opinion, the geographical distribution and, consequently, the subspecific value of forms distinguished as *ammon* and *przevalskii* is somewhat uncertain. In the enumeration of localities for *ammon* I find several which lie within the Sailüghem Range—*terra typica* for *przevalskii.* On the map, the number XXVII by which *O. ammon przevalskii* is designated, is placed *north* of the western end of the Sayan Range where *no* wild sheep occur and can not occur according to the character of the country, heavily wooded ranges with alpine zone scarcely existing. But, with all these gaps unavoidable on account of the character of the material which is scarce and difficult to get, the monograph quoted and

[16] Northern part of the Okhotsk Sea.
[17] Between the sources of Piasina and Khatanga rivers.

the preceding papers by the same author on this subject present perhaps an unprecedented amount of information concerning the Palearctic sheep.

From this systematical review, Professor Nassonov passes to an essay on genetical relations, making use of the character of the hairy coat, horns, and skull. Genetical relations of species are expressed by a diagram as reproduced here.



The mufloniform group is considered as the more primitive. The most primitive species is *ophion* and in particular its Cyprian subspecies. *O. gmelini* is already advanced by the character of its horns; of its races, *erskinei* seems to form a link to *orientalis*. On the other hand, with *gmelini* (probably with its still undiscovered southern races?) is connected *vignei*, and also *laristanica; O. musimon* seems to form a rather isolated side-branch. Of the argaliform sheep, *polii*, in its least developed forms like *severtzovi*, shows certain characters connecting it with *O. orientalis* and especially so with the subspecies *cycloceros*. On the other hand, *O. ammon*, especially in its primitive forms, *hodgsoni* and *jubata*, presents a number of characters in common with *O. vignei*. Thus the argaliform sheep are evolved in two parallel branches presenting, I may add, not a genetical group but rather a certain grade of evolution. Of the American and Siberian sheep which have many characters in common, *nivicola*, by its short ears and comparatively broad muzzle, differs more from other sheep; *canadensis*, by its lower ears and comparatively long and narrow muzzle, is considered as

standing nearer to the High-Asian sheep, and probably in genetical connection with *ammon*.[18]

Two interesting suggestions concerning the domesticated sheep are worthy of mention: *O. ammon kozlovi*, the subspecies belonging to the hill range Yabarai, which lies isolated amidst the sands of southern Gobi, is supposed to be the parent form of the Kirghizian fat-rumped sheep.[19] As the the so-called noor-sheep, the "Torf-Schaaf" of German authors, and *O. palustris* of the European Neolithic Period, it has been traced back by the American explorers to the Neolithic settlement near Askhabad, Transcaspia.[20] In the basal layers of the same settlement remains of a wild parent form were discovered which Professor Duerst refers to *O. cycloceros cycloceros*, a sheep which inhabits the Kopet Dagh Range even now. Professor Nassonov shows by the characters used by Professor Duerst that the wild form may have been as well *O. polii severtzovi* which was unknown at the time Professor Duerst's paper was published, and that the domestic races connected with *O. palustris* do not possess the very prominent character[21] which is strongly developed in *O. cycloceros cycloceros* but is also absent in *O. polii severtzovi*.

Genetical relation as shown by the morphology, then the ecology of the group, and certain facts of paleogeography form the base of Professor Nassonov's attempt at reconstructing the history of migrations of the sheep. Paleontological evidence affords but very little in this case. The above diagram of genetical relations presents also a rough outline of wanderings. Putting aside *O. musimon*, a somewhat outlying member in the geographical sense also, we find that the forms of the sheep are the more advanced or modified the further east their respective areas lie, except for *O. nivicola* which, though more modified than *O. canadensis*, has its area lying largely west of that of its less modified cousin.

The mountains of that part of the Pliocenic and Ægæan dry land whose remnants now present the island Cyprus, inhabited by the most primitive of recent forms, *O. ophion ophion*, are considered the center of dispersal. As nearest to *ophion* genetically, *armeniana* is described of which however it is said that it has invaded Armenia comparatively

[18] The short muzzle of *O. musimon*, a sheep which stands apart by many other characters, Professor Nassonov considers as a case of parallel evolution.

[19] See also another paper, in the Memoirs of the Russian Acad. of Sciences, 1914, p. 777.

[20] Pumpelly, Exploration in Turkestan. Prehistoric civilization of Anan.

[21] Collar of long hairs.

recently; *anatolica* was separated probably earlier and is more modified. The mountains of Transcaucasia are supposed generally to have been invaded by the sheep long after the glacial time, when the woodland of Transcaucasia was already developed and prevented the sheep from penetrating into the main range of the Caucasus. East of the range of *armeniana*, the dispersal went in two branches, along the mountains bordering the Iranian Plateau on the north, and along those bordering it on the southwest and south; here, forms of *O. gmelini* developed. From Elburz begins the area of *O. orientalis;* it is represented in the Elburz Mountains by its primitive subspecies *orientalis*, which partly overlaps the area of *O. gmelini erskinei*. The spreading of the group *orientalis* into Hindu-Kush may have been prevented by the presence here of another group, *vignei* (see below); migration to the north has given origin to the Ust-Urt subspecies, *arcar*, the most modified form of this species; certainly, it could have invaded Ust-Urt only from the south and this event may have taken place only after the connection between the Aral and Caspian seas had disappeared. Migration along the ranges bordering the Iranian Plateau from the south gave origin to *O. laristanica* which stands genetically near to *O. gmelini* and, on the other hand, gave origin to *O. vignei*. This last spread then to the north where it meets *O. orientalis cycloceros* near Peshawar, *O. ammon hodgsoni* in eastern Kashmir, and *O. polii polii* at the southwestern border of Pamir; the south-north direction of its spreading is disclosed by the fact that it is connected with the sheep of Baluchistan and widely different from its northern neighbours just named.

Of *O. polii*, the least specialized form is *severtzovi* of the hill-ranges of Kisyl-Kum Desert. Its origin is supposed to be postpliocenic and preglacial. It is nearest to *O. orientalis* but more advanced. Next to *severtzovi* comes, geographically and morphologically, *nigrimontana* of the westernmost branch of the Tian-Shan System. Glaciation of Tian-Shan is supposed to have shifted the forms which inhabited it in various directions and *karelini* is considered as having been developed in the west, *littledalei* in the ranges along Upper Ili and Yulduss, *collium* in Tarbagatai; and *polii*, the most specialized highly alpine form, is supposed to have reached Pamir from the northeast.

Concerning *O. ammon* which lives east of the areas of *O. polii* and *O. vignei*, Professor Nassonov rejects the idea of genetical connection of *polii* and *ammon*, through geographically nearest forms, and puts forth the fact that the most primitive races of *ammon*, namely *hodgsoni* and *jubata*, live in the south close to *O. vignei* to which they show a

certain similarity. Thence it is assumed that the dispersal of *O. ammon* went on from the south.

Concerning the subspecies which inhabit the Russian and Mongolian (or Ektag-) Altai and Sailüghem, Professor Nassonov says that "these vast areas were mostly covered by a mighty ice sheet" and, if *O. ammon* penetrated into the Russian Altai in the preglacial time, the glaciation, having driven it out, may have led to the isolation and development of the subspecies *ammon* and *mongolica; przevalskii* may represent even a mixed race. At present, the extreme northern habitats toward Siberia are Russian Altai, Tannu-ola, and the mountains near Kossogal, and quite recently also southern Transbaikalia where *O. ammon* died out in the beginning of nineteenth century. Its penetration further north is now hampered by the Siberian woodland, but it may have reached the bare summits and slopes of Transbaikalian ranges in the post-glacial time before the spreading of the woodland. Nevertheless it lived in the glacial time and even in the Paleolithic Age near Krasnoyara from where it was probably driven by the extension of the woodland which followed the post-glacial dry time. Some representatives of the alpine fauna, such as *Leucosticte, Tetraogallus* and *Capra*, still live in the Sayan Range.

As to the sheep of Siberia, Professor Nassonov supports fully the theory of double migration put forth by Dr. N. Severtzov and discussed above. It is emphasized that the Siberian sheep differ sharply from the High-Asian, even if only the forms geographically nearest be compared. Yet at the same time, the group *nivicola* is represented in America as well as in Siberia. Another American sheep, *canadensis*, which lives farther south, is closely related to *nivicola* and is nearer to *ammon* than the Siberian forms of *nivicola*. The spreading of the last over Siberia went on probably from the Chukchi Peninsula. Morphologically, the extreme form is probably *lydekkeri*. Problematic is the history of the little known *borealis* the range of which is divided from that of the geographically nearest *lydekkeri* by a distance of about 1,000 kilometers of woodland. A supposition is put forth that *borealis* may have come here along the Viluisk Range when it was not wooded. In any case, a direct genetical relation of Siberian sheep with those of High-Asia is totally excluded.

I have endeavored to clarify here the works of two Russian zoologists on the Old World sheep. Each of them based his studies on vast and partly new material. Severtzov had also the advantage of his field work; and Nassonov possessed as complete material on the sheep of

Asia as scarcely anybody before him. But, both of these Russian zoologists have found that the American continent has been also a playground in this complicated history, and of the American sheep their material was very incomplete. Surely, a study of the American material will contribute greatly to an understanding of the history of the wild sheep, which for the American forms could only be touched by the late Dr. N. Severtzov and Prof. N. Nassonov.

I shall add a few personal remarks and supplements to the foregoing. As to the general points, it may be objected to Professor Nassonov, as well as to Doctor Severtzov, that a descendance of recent forms from others also recent is too largely admittd in their constructions. Of course, such a descendance is not impossible especially in the case prevailing here where the evolution is connected with a spreading out, and an advanced or modified descendant does not come into contact and concurrence with its ancestor still living, and can not contribute to its extinction. Anyhow, a relation of this kind is to be taken with a certain reserve. Another point is that no sharp distinction is made between a primary endemism and a relic endemism, when a form becomes restricted to a certain locality as a result of a contraction of its primary area or even of a shifting; and this is especially to be considered with primitive and insular forms.

As to the interpretation of some geographical and systematical facts, I think that the proximity and part overlapping of the ranges of *O. gmelini erskinei* and *O. orientalis orientalis* should speak against their direct connection, and for their being independently evolved and having invaded a certain country from different points.

My own study of the zoogeography and history of the fauna of Asia allows me to make some additions concerning the history of migrations. Remains of *O. ammon* have been found in the fluviatile sand and gravel deposits and at a later date with the Paleolithic remains near Krasnoyarsk. At present the nearest habitats of *O. ammon* lie in the Russian Altai and Tannu-ola, some 300 kilometers from Krasnoyarsk. But one of the usual faunal associates of the *argali* sheep in the Russian Altai, *Leucosticte arctoa*, still forms an isolated colony at the sources of the Mana River, and another at one of the few alpine summits of the Sayan Mountains. And generally the heavily wooded ranges of Siberia show on their alpine summits, which emerge like islets amidst the ocean of woodland, isolated alpine elements which are but poorly represented at any particular spot but when taken together give a nearly complete list of the alpine fauna of the Altai. Thus the insular and relic character of these isolated findings is clearly shown.

A set of the zoological, botanical, and pedalogical (i.e., concerning foot-print science) facts shows that the present extent of the coniferous woodland in Siberia is recent. Degraded steppe soils and vestiges of desert erosion and accumulation have been found in several places in wooded country, patches of steppe flora and fauna ranging from small isolated, vanishing relics to large areas have been found amidst the coniferous woodland, and fossil remains of steppe forms have been discovered far north. So far as the sequence is established, the steppe soils overlie the traces of the pluvial period which was contemporary with the glaciation. Thus, in Siberia also, the glacial period has been followed by a dry steppe period when the northward migration of the steppe forms took place. Later the woodland spread over the steppe landscape. Traces of these changes are found from Transbaikalia and surely as far north as Irkutsk. About the same time, also a northward spreading of the High-Asian forms occurred. I place it at the time from the beginning of the glacial period—when the timber line was lowered and the alpine zone, shifted to the base of the mountains, occupied more space and became more continuous—to the time of the spreading of the woodland which invaded the open landscape, both of the lowlands and highlands, and reduced it to mere islets with their relics of fauna and flora.

The surmise made by Professor Nassonov, that the ancestors of *O. nivicola borealis* which is now isolated by woodland may have come *via* Viliuisk Range, I support fully. I accept the theory that the famous remnants of the non-tundran animals of the New Siberian Islands have been brought from the south by the Lena River, of which these islands formed a part of the delta. But remains of the saiga antelope, partly water-worn and surely brought also by water have been found at the mouth of the Olenek River, which shows that the saiga antelope and the open landscape condition existed at the source of the Olenek which flows from the Viliuisk Range.

As to the glaciation of Altai and Mongolia, I am afraid that Professor Nassonov's assertion is too diagrammatical. Northwest Mongolia was very scantily glaciated, many ranges not at all (see also papers of Professor Grano and Professor Sapozhnikov). From my studies of its fauna I have also come to the conclusion that this region served as an asylum during the glacial time, and had assumed its present semidesert character before the glacial sheet of Altai was gone. As to the *argali* sheep in the Russian Altai, I am almost certain that it came there even after the last glaciation and during the general spreading of the High-

Asian fauna. To this conclusion I come through the absence of *O. ammon* in Tarbagatai. If *O. ammon* had been a member of the preglacial fauna of Altai, surely it would have been driven south, as many other forms were which have reached Tarbagatai and even Tian-Shan. The presence of *O. polii collium* in Tarbagatai would scarcely form an obstacle to this view, as sometimes different species of sheep live together, and the conditions under which *Lagopus mutus* has reached Tarbagatai would be more than sufficient for the corresponding migration of *O. ammon* across the valley of Irtysh.

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A LIFE HISTORY PROBLEM AND A MEANS FOR ITS SOLUTION[1]

By William T. Shaw

[*Plates 15–17*]

Those who have attempted an intensive study of the lives of small mammals will have encountered many difficulties, the chief of which are associated with lack of absolute control of the species under investigation. In 1910 the writer undertook the problem of determining the activities of the Columbian ground squirrel (*Citellus columbianus columbianus*). To one uninitiated this seemed a simple task to be completed in a few months at most, yet, almost at once, hidden phases of the active life of the animal presented themselves for solution and it was soon seen that these could not be solved without complete mastery of the goings and comings of the animal. To this end it was decided to construct a plant in which careful observations could be made, exact data be taken and points of interest be recorded. The investigation naturally grew in complexity and, instead of being completed after a few months' study, it required five years. It is, however, with the development and construction of the means of control that this paper is chiefly concerned.

Early in this investigation it became apparent that many of the points in this life history would never be learned from wild squirrels at liberty

[1] Published with the approval of the Director of the Washington Experiment Station as Scientific Paper No. 124, College of Agriculture and Experiment Station, Pullman, Washington.

in the fields. It was necessary, however, that these difficult points should be studied under as nearly natural conditions as possible, otherwise the value of the observations would be greatly reduced. During the winter of 1910 and 1911, it was decided to fence in a space of ground wherein squirrels might be kept and studied at the convenience of the observer. A tract of original bunch-grass land was selected. Here were found, projecting from the snow, old unused mounds of the Columbian ground squirrel, little grass-covered hillocks still bearing traces of former occupation. These mounds were the external indications of underground dens of 20 or 25 feet in diameter. This seemed the opportunity, and it was not long before we had decided to utilize two of these adjacent dens. As the snow disappeared other nearby mounds began to show, the whole forming a small colony admirably adapted for growing needs.

The first desire was to make two yards or huge cages which would hold squirrels under perfect control, and at the same time give them great freedom. Accordingly, work was begun in late winter, so that the enclosures would be ready for the breeding investigations which it was desired to carry out first. A space was accurately measured off, and with pick and shovel the surface layer of snow and frozen ground was removed and trenches surrounding the dens were sunk to a depth of 6 feet. The space thus enclosed was divided by a trench separating the two dens, resulting in the formation of Yards 1 and 2, as shown in figure 1. Here squirrels were placed, and here they began activities under essentially normal conditions.

It soon became apparent that it would be necessary to have some provisions made for taking observations, as this species was very timid, and in order to get some data, such as that relating to the gestation period, development, and growth of the young, which could not be secured with the squirrels in the dens, additional structures would have to be added. Accordingly, to meet this need, a cabin, provided with small observation windows and nest boxes and with small connected yards, was constructed, as shown in figure 2.

THE CONSTRUCTION OF THE ORIGINAL YARDS

The actual construction of these yards (fig. 4) was as follows: A section of the outside fence all round was made by using heavy boards, 12 inches by 1 inch, for the part reaching from the bottom of the trench to the surface of the ground. Above this, shiplap extended about 2 feet and 4 inches, to where 1 inch mesh wire netting began and extended

to the top of the fence. Wire netting was used in part in order that the conditions of wind and air would be more natural than would be the case if boards had been used all the way up. On the other hand, owing to the location of the yards, they being more or less exposed, it was necessary to protect these timid animals by a low wall or board fence. This material was supported by 4 by 4 posts every 12 feet, with a 2 by 4 between. On top of the posts, projecting in, was a 12 inch by 1 inch board placed at right angles to the fence, this being necessary owing to the fact that this species of *Citellus* climbs rather well. For this reason it was found necessary to keep it off the sides of the cabin by similar contrivances or by the use of smooth boards. The dividing fence differed from this outside one, chiefly in the fact that two boards were necessary on top of the fence, one projecting into each yard; by the necessity of having the fence above ground made of wire netting in order that the conditions would be more natural with an uninterrupted strip of the original bunch grass extending through both yards; and by the possession of two lift gates, 19 inches square, operated by strings from the quiet of the cabins. These were used especially in gaining information on the gestation period. The lumber used in the construction of the yard fences and cabins was carefully painted with a coat of creosote to add to its preservation. Incidentally much was added to the appearance of the yards by the use of this material which imparted to it a warm brown tone.

BREEDING CABIN AND YARDS

The construction of this part of the yards was as follows: The breeding cabin (*fig. 2*) was made of 12 inch by 1 inch smooth boards and covered on the roof with tar paper. It was a lean-to of gentle slope. Its floor dimensions were 6 by 12 feet. Along the wall next to the breeding yards were four compartments, 3 feet long by 1 foot by 1 foot, in which the squirrels were placed to bear young. These compartments, furnished with a nest box in one end, connected with the yards by small openings in the wall which could be closed by a slide door.

The breeding yards were 8 feet by 3 feet, and 5 feet 3 inches high. On the ground a 12 inch board was placed to which ½-inch mesh wire net was attached which extended up 1 foot 8 inches. The reason for using ½-inch mesh wire was because of the small young squirrels. Then a 6 inch board was placed at right angles to the wire. It was later found necessary to extend a removable wire screen made on a frame clear across these six-inch shelves. Above this, 1 inch mesh wire

extended up to and over the top of the yard, enclosing it completely. Over the yards were 2 by 4 inch rafters where a loose board roof might be placed in winter or during extremely bad weather. Each of these small yards had a board wall made of 1 inch by 12 inch material dropped about 18 inches into the ground and was floored with 1 inch wire netting.

In this cabin the investigator could remain quietly studying the movements of the unsuspecting squirrels through the observation windows, with the use of binoculars, or manipulating gate or trap strings as occasion required.

CONSTRUCTION OF YARDS FOR THE TOWNSEND AND DOUGLAS GROUND SQUIRRELS

These original yards and the cabin having been constructed, it was thought desirable to add additional yards for the study of the Townsend ground squirrel (*Citellus townsendii*). This led to the construction of similar retaining fences for the yards 9 and 10 (fig. 4). These fences were essentially the same in structure as those already described, except that a slight change was found necessary in order to keep the animals off of the wire netting through the meshes of which they could pass, owing to their small size. This was prevented by putting a shelf below the netting and just above the boards on the inside of the fence. There was a ½ inch mesh wire netting partition separating these two yards for a part of the distance across the dividing fence. This partition fence had one lift gate 19 inches square.

Later an additional species, the Douglas ground squirrel (*C. douglasii*), was studied. This animal being a good climber special construction was required for Yard 7 in which it was retained (fig. 4). This consisted of an in-reaching shelf, 18 inches wide, from the inner edge of which hung a 6 inch strip of galvanized sheet iron. Further precaution was made against escape by covering the side of the cabin next the yard with sheet tin.

THE HIBERNATION CABIN

The next step in the development of the plant was the construction of the hibernation cabin (fig. 3) to be used for an observation cabin for Yards 9 and 10; but chiefly for the study of the aestivation and hibernation of the different species under consideration. This cabin, provided with a small basement, was used during the late summer and winter for studying hibernation. Its construction was as follows:

The hibernation cabin was built of 12 inch by 1 inch smooth boards

and was covered on the roof with tar paper. It was a lean-to cabin 7 feet 2¼ inches on the high side and 5 feet 6 inches by 14 feet. Under the floor was a cellar 2 feet 2 inches by 14 feet. Doors opened from this cellar into the hibernation boxes 10 inches high, 2 feet 9 inches wide and 18 inches back. There were two tiers of these observation boxes one above the other as the berths on one side of a sleeping car. On the side of the box opposite the door were chutes leading from each box to the small yards above ground.

There were five hibernation yards joining the cabin and connected there with small doors. These yards were 8 feet by 2 feet 9 inches. Shiplap rose from the ground up about 2 feet around these yards. They were separated by a 1 by 12 inch board resting on the ground, above which came a strip of ½ inch mesh wire netting to the top of the shiplap. They were covered from the shiplap up with 1 inch mesh wire net. There were 2 chutes 4 by 4 inches in each yard for squirrels to go below to the hibernation boxes. There were 2 by 4 rafters over the top of the yards on which a loose board roof might be placed in winter. The squirrels were prevented from escaping from the small hibernation yards through the earth by a wall in the ground similar to that of the breeding cabin, except that the wire netting in the floor was ½-inch mesh.

As the experiment grew in complexity it was found convenient to illuminate the cabins with electricity. This was done not only for purposes of lighting but for flashlight work as well.

PRECAUTIONS

Owing to occasional serious losses from predatory birds and mammals, it was found desirable to guard against this danger by the construction of an inner yard, by running a dividing fence through the interior enclosure between the cabins, and roofing over the enclosure (Yard 16, fig. 4) with 1 inch wire netting. Here the more valuable squirrels, being kept for such purposes as age data, were placed.

In general it was found necessary to observe the greatest precaution in the matter of minor detail in the construction of the retaining fences and cabins, as the slightest defects were sure to be detected sooner or later, and escape attempted through them. On the other hand it was found, after four years experience with the two species, *C. c. columbianus* and *C. townsendii*, that it was not necessary to put the retaining wall so deep in the ground, as the squirrels seldom showed any desire to escape by digging under the fence. The only real need for sinking

deep trenches was to cut off any existing burrow, and this might be avoided by placing the fences farther away from the center of the den. This would have the added advantage of enlarging the amount of surface space of the yard. The fence might do quite well two feet deep if it were far enough away from the den, the radiating burrows of which all rise, as their distance is increased from the center.

In the matter of yard construction in general, it became apparent that if the plant were to be used continuously for a number of years it would be advisable to construct the underground part of it with concrete. Lumber in moist soil is not durable and within a year or two has to be replaced.

ORIGINAL VEGETATION AND GARDENS

To the fact that the original bunch-grass sod with all its varied vegetation, balsam root (*Balsamorhiza*), flags (*Iris*), rose (*Rosa*), bunch-grass (*Agropyron*), bluegrass (*Poa*), starflower (*Trientalis*), snowberry (*Symphoricarpos*), existed over these dens and subsequently in the enclosed yards, is due a large part of the success of the investigation. Here the squirrels were practically at home, with at most a very slight restraint, and it was an unusual thing to see one endeavoring to escape from the large yards.

As an accessory to the plant it was soon found desirable to supplement the natural food at some season, and to raise food for those squirrels in closer confinement. This was done by establishing adjacent gardens where such plants as were found to be most suitable were raised. The garden planted was chiefly of sunflowers and carrots, the seeds of the former and the roots of the latter being found the foods above all others most sought by the squirrels.

State College of Washington, Pullman, Washington.

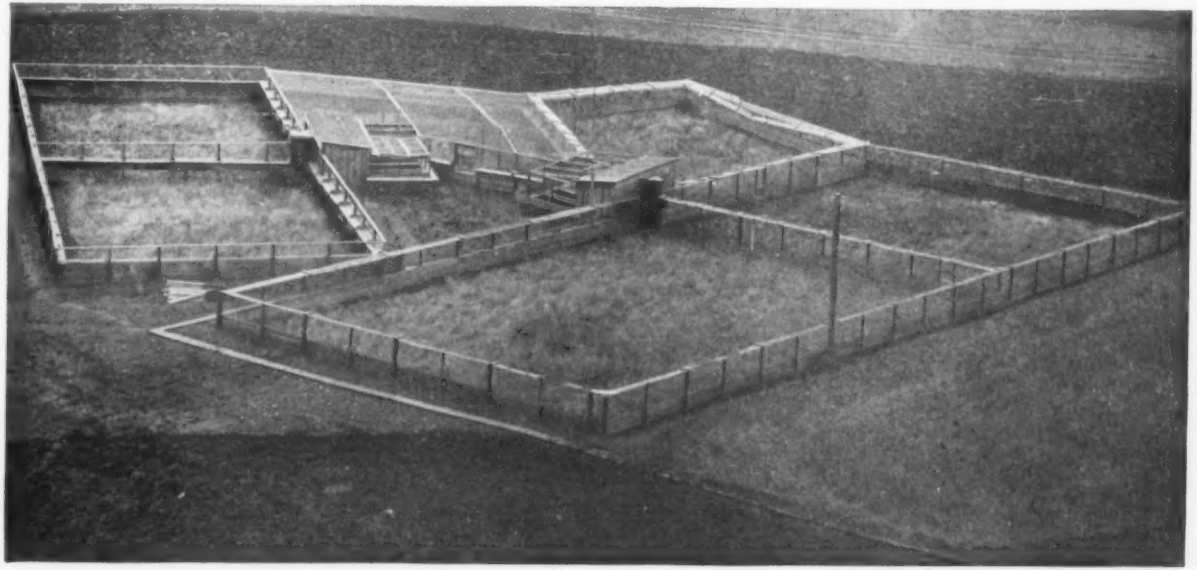

FIG. 1. A BIRD'S-EYE VIEW OF THE PLANT

In the photo are shown five large yards, containing old natural dens, two retaining yards in the center, and a breeding and a hibernation cabin, both of which were used for observation cabins as well.

FIG. 2. THE BREEDING CABIN IN WHICH DEVELOPING YOUNG WERE KEPT

Back of this cabin are small yards in which the squirrels could run, but from which they could not escape into the larger yards.

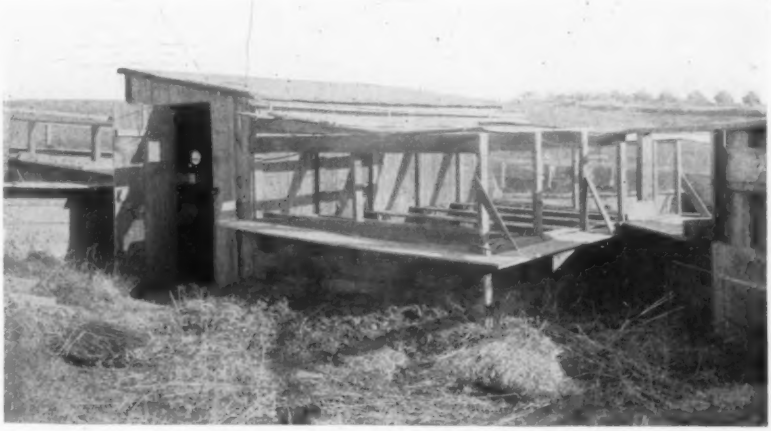

FIG. 3. HIBERNATION CABIN, WHERE SQUIRRELS COULD PASS FROM THE SMALLER CONNECTED YARDS THROUGH TUNNELS TO HIBERNATION NESTS IN A BASEMENT CELLAR

Here they could be taken out at pleasure, observed, and returned to the nest without being awakened.

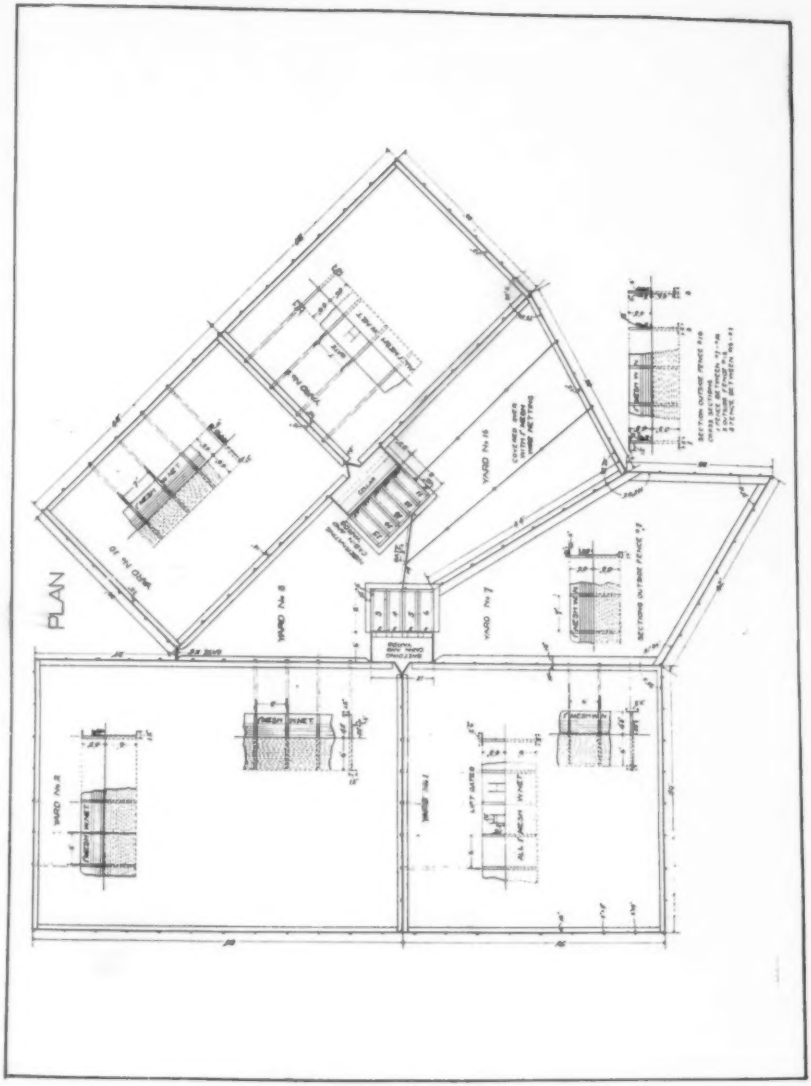

FIG. 4. PLAN OF THE PLANT

PATHOLOGIC SKULLS OF CAPTIVE LIONS

By A. Brazier Howell

In connection with another investigation, the present writer found it advisable to review critically the material used by the late N. Hollister in his paper, "Some effects of environment and habit on captive lions."[1] In this paper it is pointed out that park-reared lions have skulls that are shorter, broader, and much more massive than those of wild-killed animals from the same region. This massiveness occurs in all parts of the skull, and the differences between the two lots are certainly sufficient in degree to be considered of specific significance had all the skulls come from wild-killed animals, as Hollister mentioned. Especially noteworthy in this connection are the great size of the mandibular condyles and glenoid fossae, small capacity of the braincase, great zygomatic width and robustness of the arches in the park-reared individuals, the thickness of the arches varying as much as 250 per cent in the two lots.

The above skull characters, in slightly differing degree, also obtain in the Menelik lion, the type of *Felis leo roosevelti* Heller. It is also noted by F. Wood Jones[2] that after a lion had lived seventeen years in captivity, its cranial capacity had undergone a marked diminution, and that the anterior portion of its skull had suffered alteration. Hence, a change in cranial characters may be considered as a usual result following a lengthy period of captivity in the case of a lion.

Hollister has assumed that all of the differences to be found in the skulls of the captives are directly attributable to variations from normal in the development of the muscles and muscle-stresses, and that these in turn have been caused by the artificiality of feeding habits in captivity. He logically and very properly argues that in confinement the muscles of chief value to an animal in tearing and gripping heavy prey are undeveloped because of slight use, and it is gathered from his discussion that he does not consider it likely that the muscles chiefly employed in cutting and crushing the food are of markedly different development in the two classes, although he does not so state. The premise that the tearing and rending muscles of the head are weaker in lions raised in captivity is almost certain to be true. In the wild this animal habitually kills bulky prey, which necessarily

[1] Proc. U. S. Nat. Mus., vol. 53, 1917, pp. 177–193.
[2] Proc. Zool. Soc. London, 1917, p. 333.

means the strengthening of the muscles chiefly concerned in closure of the anterior portion of the jaws.

If this be admitted and we follow the resulting hypothesis that the peculiarities exhibited by the skulls of the captives are the result of myological stimuli, then it will be necessary to discard most of the criteria which we are in the habit of employing for judging the strength of musculature according to the angularity and "strength" of the bones; but all the evidence at our command seems against such a course.

The general massiveness of the skulls of the captive lions is very remarkable, although they lack some of the sharpness of detail, especially in the zygomatic arches, that is shown by the muscle origins in skulls of wild-killed animals. From an examination of the one skull of either class that is particularly emphasized in Hollister's paper, one would pronounce that of the captive, if judged by size alone, to be 15 or 20 per cent heavier than that of the wild specimen. Such is by no means the case, however, for the former weighs two ounces *less*. The discrepancy is due to the softer, more spongy nature of the bone in the captive. Although the softness of this skull is more marked than in the two captive females at hand, it is decidedly less so than in the other male.

Reference to Hollister's illustrations and measurements shows the differences existing in many of the external parts. Although the braincase *seems* to be more capacious in the captives, cranial capacity is in every case actually smaller than in wild animals of the same age and sex. Sections cut from the mid-dorsal portion of the cranium of each show that in the wild skull the ectal layer of compact tissue, or table, is very tough and dense, with an average thickness of slightly more than 3 mm. At some points it constitutes the entire cerebral covering, while at others there is the usual, irregular layer, sharply differentiated, of cancellous or diploic tissue. The ental table is thinner than the ectal and is less well defined. Although the ectal table in the captive has a smooth surface, it is exceedingly thin, is not at all clearly differentiate, and passes rapidly though insensibly (in some places at least) into the diploe. The parietal bones of the captive average at least twice the thickness of those of the wild individual, and the inner surface of the bone of the former is spongy, roughened, and pierced by a multitude of small foramina. The olfactory fossa of the captive is much reduced in width but not in height, its dimension being 10 by 25 mm. as compared with 15 by 25 in the skull of the wild lion; and the frontal sinuses of the former are also very much the smaller. Practically all sutures

upon the ental surface of the braincase are obliterated, which is by no means the condition found in the wild example. The height of the foramen magnum in this (as well as in all skulls of available captives) is much reduced, as are the external openings of the foramina rotunda and optic foramina. The internal openings of the latter are now completely closed, and the basal vestibule, into which open the foramina rotunda and ovales and the sphenoid fissures, is so much reduced in size by the encroachment of its bony margins that there must have been definite interference with the normal functioning of the nerves involved. Mention of those foramina showing closure, with the cause of the death of each park-reared lion, follows.

No. 199707,[3] ♂, Optic foramina closed; foramina rotunda constricted; height of foramen magnum reduced to 15.5 mm. (normally about 22). Finally shot as he was unfit for exhibition: had been blind for several years and autopsy showed softening at the base of the brain.

No. 197944, ♂. Closure of optic foramina well nigh complete; height of foramen magnum reduced to 13.3 mm. Had been blind for about three months but seemed to be recovering his sight: died of chronic gastroenteritis after an illness of about ten months.

No. 197137, ♀. Foramina rotunda somewhat constricted; height of foramen magnum reduced to 15 mm. (normally about 22 in females) Was shot because walking was accomplished with extreme difficulty.

No. 199524, ♀. Foramina rotunda somewhat constricted; height of foramen magnum reduced to 15 mm. Died of pericarditis after six weeks illness.

No. 176201, ♀. Skull could not be located. Choked to death while eating.

It is significant that all four of the skulls now available show that the animals were in a pathologic condition at the time of death, and that all exhibit a tendency towards the closure of certain foramina—notably the foramina rotunda, through which pass the maxillary nerves; to a lesser extent the optic foramina; and invariably the foramen magnum. The closure of the last is accomplished through reduction of the vertical measurement by bony accretion upon its superior margin only. A similar condition exists in the skull of the Menelik lion[4] (height of foramen magnum 15 mm.), but is not to be found in the skulls of two leopards (*Felis pardus*) which died in the National Zoological Park. There

[3] All skulls of lions examined are in the collection of the U. S. National Museum.

[4] As the characters on which the description and naming of *Felis leo roosevelti*, of which this specimen is the type, are pathologic, and the locality from which it originally came is unknown, there is no course open save to place the name in synonymy. That such action might be advisable was suggested by Mr. Hollister, but he did not take it himself.

is no sign, however, of a reduction in the size of the neural canals of the atlas and axis of lion No. 199707, which vertebræ were the only ones of any of the captives to be preserved. Just what state of the animal finally results from constriction of the foramen magnum, and hence reduction in the size of the spinal medulla, is not known, but some abnormal condition of the nervous system would be indicated.

The difficulty experienced by at least one of the animals in walking and certain details of the skulls of captive lions that have been mentioned above (notably the robustness and composition of the bones and the obliteration of clear differentiation between the diploe and tables of the cranium) are characteristic symptoms of osteitis deformans or Paget's disease.[5] This is one of probably several diseases of the bone, not sharply differentiated one from the other nor well understood, which are characterized by almost simultaneous absorption of compact bone, chiefly of the cranium and long bones, and redeposition of an excess of fibro-osteoid tissue.

As long ago as 1884, Sutton[6] described a condition to be found among captive carnivores which he termed late (postpubertal) rickets. Among his material hypertrophy of the skull vault was a quite characteristic symptom. In addition, medical literature is replete with references to deformation of the bones of humans of a comparable nature.

Accurate diagnosis is hardly possible merely from an examination of the prepared skulls, especially as the specimens in hand show no undue enlargement of the alveolar borders—a symptom rather characteristic of very advanced cases of osteitis deformans; but the premise may be advanced with considerable confidence that the condition of the skulls of the captive lions is the result of a disease of this nature.

The etiology of Paget's and similar diseases is still a matter of some dispute, but opinions incline to the hypothesis that it is due to an abnormality in the production of secretions by some of the ductless glands. The fact that the condition seems to be uniformly found in the skulls of lions long in captivity suggests that the contributing cause has been the absence from the diet of some needed element such as a vitamin of the anti-rachitic type.

It should be noted that the capacity of the braincase in park-reared lions is strikingly less (20 per cent for males; 18.5 per cent for females)

[5] See standard medical works, and Fox, H., Disease in captive wild animals and birds, Lippincott & Co., Philadelphia, 1923.

[6] Sutton, J. B., Diseases of carnivorous animals in zoos, Proc. Zool. Soc. London, 1884, pp. 177–187.

than in wild examples. Of considerable interest in this connection are some other available facts, as follows. It is stated by H. H. Donaldson[7] that the capacity of the braincase of cage-born individuals of *Cavia cutleri* was about 8 per cent less than in the case of specimens caught wild; but skulls of the former weighed *more* (15.5 per cent for males; 11.7 per cent for females).

The relative weight of the brain in the F_1 and F_2 generations of cage-born brown rats (*Rattus norvegicus*) averaged 5.7 per cent less for males, and about 3.7 per cent less for females, than of wild examples. The differences were very much greater when the albino rat was compared. I regard any such figures as untrustworthy, however, when based upon either "white" rats or domestic rabbits, because we can not be sure of the precise races from which these stocks were originally derived. I therefore question the significance of work based upon a comparison of either of these mammals with their wild relatives.

In the cases both of the lions and cavies captivity, or rather conditions encountered during captivity, has increased the massiveness of the skull. In these and the rats as well there has also been a reduction in the capacity of the braincase of the captives, and it is interesting to note that the percentage of decrease is invariably less in the case of the females. In other words captivity reacts more strongly upon males than females, at least as far as this one particular is concerned.

It has been found[8] that the marked reduction in the size of the brain of the albino rat as compared with that of its darker relative is apparently due to a decrease in the size, rather than in the number, of the cerebral neurons. This being the case, it is probable that the same condition obtained in the smaller brains of the captive lions, cavies, and brown rats. The significance of this cannot be precisely interpreted.

The foregoing data indicate that in the captive lions under discussion there was induced by the life and food an abnormal, bony growth of the skull, the abnormality probably being hardly influenced by myological characters, and not greatly by racial tendencies. Although these skulls are very interesting because of showing the variational development possible under certain dietetic and other conditions, they must be considered as pathologic, and the conclusions to be drawn from their study have little or no application to the morphology of the normal skull.

[7] On the cranial capacity of the guinea pig—wild and domesticated, Arch. Suisses Neurol. Psych., vol. 13, 1923, pp. 206–222.

[8] Sugita, N., Journ. Comp. Neurol., vol. 29, 1918, pp. 61–117.

N.B. Since the completion of the above contribution I have had called to my attention several references which Mr. Hollister had gathered and placed among letters referring to his lion paper. It is only fair to note that these indicate the possibility that he may have altered his original opinion that the skulls of the captive lions are the result mainly, if not entirely, of myological stimuli, and that he may have finally considered them pathologic.

U. S. Biological Survey, Washington, D. C.

TRAPPING LAWS AND THE FUR SUPPLY

By Frank G. Ashbrook

The preservation of fur-bearing animals in the United States is just as much a public issue as the preservation of any other natural resource. While the administration of our forests, fish, and game may rest with either the individual states or the Federal Government, fur-bearing animals are the property of the states and the maintenance of the fur supply, therefore, must be brought about through the enactment of state laws. The value of the annual catch of fur bearers in the United States twenty-five years ago was roughly estimated at about $25,000,000. Today we estimate it at $60,000,000. Persons vitally interested feel that the fur resources are not being given all the attention they deserve, particularly with this monetary showing. Cooperation is necessary to encourage the passage of proper legislation concerning fur animals. Wasteful methods in trapping and in the fur trade should be prevented, just as the indiscriminate felling of forests has been controlled. Better laws and stricter enforcement would not only increase the quantity but would greatly enhance the quality of the annual fur catch.

Persons who have not given considerable thought to the fur-bearing-animal situation are prone to blame trapping and trapping methods for the scarcity of the animals in certain sections of our country, forgetful of the indiscriminate drainage of swamps, the cutting down of trees, and the encroachment of civilization, all of which have greatly reduced the natural fur-producing areas. The fact that many trappers have been permitted to ply their trade out of season and to gather pelts to the point of extermination of the fur bearers over large areas is another cause of our present shortage. Serious responsibility rests also on fur buyers and their agents who, by accepting at a price all skins offered,

and thus carrying to the markets illegal pelts, tempt the trappers to make a thorough clean-up along their trap lines.

We are confronted with the problem of relative values of the animals we seek to conserve and the birds or animals upon which fur bearers prey, or, as in the case of the beaver, the value of the pelt as compared with the damages the animal does to lumber interests and farm property. These factors are of importance in the reduction of the number of fur bearers in the states where the question is decided against the animals.

Better laws and stricter enforcement are needed for the proper protection of fur bearers. The lack of authentic information on the part of farmers, trappers, and members of the fur trade, of legislative committees, and even of conservationists is the cause of inadequate laws. The majority of laws now on the statute books do little to prevent the decrease of fur bearers in certain sections of our country. A frequent defect in the present laws for fur protection is that the open season is so long as to permit trapping before the pelts are prime in fall and after breeding is in progress in spring. That the seasons are not wisely determined is emphasized by the fact that far too many of the pelts coming to the raw-fur markets fall into the unprofitable class. A keener appreciation of conditions shown by studies of the habits, breeding seasons, and periods of prime fur for the various species on the part of those concerned with the framing of laws and regulations governing trapping would have the result that a greatly increased quantity of pelts with fur of a superior quality would reach the markets, thus increasing the financial rewards to trappers for their efforts and at the same time allowing increased numbers of breeders to remain in the covers.

Furs of many kinds were commonly taken in all sections of the country a few generations ago, but now over great areas, with the depletion or extinction of certain of the more prized species, the most valuable fur bearers, from the standpoint of financial returns from the annual catch, are the muskrat, skunk, raccoon, and opossum. Of the four, the muskrat is the most valuable fur producer in the United States. Its increasing use for fur and meat makes it most desirable to preserve and perpetuate it as a natural resource. As a staple in the American fur market, the muskrat is considered the most important fur animal. Some dealers, considering it the barometer of the fur industry, say, "As goes the muskrat, so goes the market." Although injurious in some localities, the muskrat is for the most part an inhabitant of places unsuited to agriculture. Muskrats increase much more rapidly than

do other fur bearers, and because of their aquatic retreats and general habits, are better fitted than most animals of this class to maintain their numbers under the little protection now afforded them.

In certain sections of our country where the open season is from four to six and one-half months, the muskrat is becoming very scarce. It is still unprotected in ten states, and in 23 states has to face an open season of more than three months,—in eight of them five months or more. In only eleven states is the season three months or less, while in two states the muskrat is protected throughout the year. The persons responsible for the enactment of the laws do not always realize that the most valuable skins are those taken late in winter and early in spring. Muskrats within the United States should not be taken before December 1, and while the fur is still prime when the breeding season is in progress in the latter part of March, continued trapping would greatly affect the number of young animals for the next year. The open season should be limited to three months, December 1 to March 1, or in the more northern states, December 15 to March 15.

Next in importance to the muskrat as a source of fur is the skunk. This animal brings to the trappers of the United States millions of dollars annually. Thirty-four states now have laws protecting skunks, with open seasons of one and one-half to six months. These laws were passed largely in response to the wishes of farmers, who recognize the usefulness of these animals in destroying noxious insects, and to the demands of persons interested in conserving the fur resources of the country. There are still fourteen states that give no protection whatever to skunks, and one which protects them in only a few counties. In view of their usefulness and fur value, skunks should be protected everywhere by a close season of at least nine months, but the right of farmers to destroy predatory skunks should always be reserved. The skins of skunks are prime from about the middle of October to the middle of February. Trapping the animals as late as March or April should be prohibited in all states.

The raccoon has claims to protection as a fur animal to say nothing of its value as food and game. Though probably less esteemed than the opossum, its flesh is eaten in many parts of the country. Affording fur, food, and sport, it is strange that this animal should not be more highly valued and protected throughout its range during the breeding period and the time of unprime fur. Yet it shares with many other fur animals the charge of being harmful to poultry, and this fact has doubtless delayed favorable legislation. Thirty-seven states give pro-

tection to the raccoon, with open seasons ranging from one to five months, while it is still unprotected in ten states.

The importance of the opossum as a fur animal is just beginning to be recognized. Its combined value for fur and food makes it worthy of careful protection. The natural habitat of the opossum is confined to approximately twenty-nine states, and it is given protection in twenty with open seasons ranging from two to four and one-half months. It should be protected in all twenty-nine states by a close season beginning not later than March 1 and extending at least to November 1. This would protect the opossum during the period of greatest reproduction.

The fur bearers previously mentioned are the most important from the economic standpoint, but the pelts of certain others have a higher individual money value. All fur bearers need proper protection if their numbers are to be maintained and good fur is to continue to be produced. Legislation pertaining to fur bearers should be state-wide, so that every section of the state may be equally affected. Persons responsible for framing fur-animal laws should be open-minded, not allowing themselves to be swayed by any one interest at the expense of another, and should give as much consideration to trappers as to hunters of game and game birds.

A definite and mutually satisfactory policy between sportsmen and fur traders should be established in respect to "vermin" control. Fur-bearing animals are a natural resource that should be perpetuated and every effort should be made to ascertain the status of any species before legislation is enacted for or against it. Such fur-bearing animals as beavers, raccoons, and opossums should be classed as fur bearers and not as game animals, or both. These are trapped primarily for fur and are more valuable for this purpose than for food. Shooting or gigging fur animals should be prohibited except perhaps the shooting of raccoons and opossums.

Three months is a sufficient open season for any fur bearer, and it should include the time when the fur is prime and not the breeding season or hibernation period. A close season should be placed on any animal in danger of extinction. Extending the open season into the hibernation period is an invitation to the trapper to drive out the animal by chemical or mechanical means.

The terms "prime" and "legal" are very confusing to wardens and fur buyers. A trapper can not tell whether or not the pelt is prime before he skins the animal. The outside appearance is not conclusive evidence on the matter.

It is impossible to define what is an unprime and what is a prime skin. The only application "unprime" could have to the law would be to skins taken in close season. These would be skins taken illegally. "Prime" should refer to skins taken legally, and "unprime" to skins taken illegally, then fur companies as well as game officials would understand the meaning of the terms. The terms "legal" and "illegal" might even be used in defining the law rather than the terms "prime" and "unprime."

One of the most important features of present-day legislation on fur animals is that of requiring trappers to make annual reports of the number of each species taken. The trapping license, aside from its revenue-producing possibilities, affords the best-known means for the registration and identification of trappers, and its renewal from year to year should be conditioned upon the filing of satisfactory returns on the catch of the previous season. The data to be obtained from these reports would provide a sound foundation for a survey of the annual kill and its relation to the breeding supply, or capital stock as it may be considered, and it is on such surveys that protective measures should be based. Given an intelligent estimate of the fur resources of a state, it becomes comparatively simple to frame legislation designed to permit the harvesting of the annual fur crop in its prime and most valuable condition and at the same time to build up and adequately safeguard the breeding stock.

CONCLUSION

The spirit of the Department of Agriculture as regards fur bearers is one of coöperation and of coördination, and not one of Federal control. The Department has no voice whatever in making laws of the states relating to seasons on fur bearers.

This year (1925) 41 states held legislative sessions and thirteen states are considering legislation relative to the protection of fur-bearing animals. The Biological Survey has, on request, rendered assistance to a great many state game officials in matters pertaining to fur-bearing-animal legislation. It is also coöperating with the National Association of the Fur Industry in this and other matters pertaining to fur-bearing animals. This association is strongly in favor of the conservation of wild life, but insists that conservation must include fur animals. This is very reasonable when we consider that trappers' license fees are used for the protection and propagation of fish and game and very little of the revenue so derived goes directly to the cause of fur conservation.

Conflict of interest between sportsmen and fur traders is a useless waste of time and energy. Sportsmen and fur traders should work out their problems together and present a united front in urging legislation concerning conservation. The greatest degree of coöperation and foresight on the part of everyone is essential if all species of fur bearers are to be retained permanently, both for enjoyment in the wild and for reasonable use, and the fur industry is not to be jeopardized.

U. S. Biological Survey, Washington, D. C.

NOTES ON SOME MAMMALS OF MONTMORENCY COUNTY, MICHIGAN

By Morris M. Green

Some observations, necessarily limited, made during a fortnight's stay at Valentine Lake, Michigan, in the summer of 1922, impressed me with the apparent mingling of southern and prairie animals, such as the mourning dove, bob-white, massassauga rattlesnake, box tortoise, badger, prairie mole, and prairie cottontail with such northern forms as the red-bellied nuthatch, hermit thrush, junco, yellow-bellied woodpecker and porcupine. It was possible for me to conduct an intensive trapping campaign for small mammals at this locality from July 12 to 28, 1924, for the purpose of identifying the local species. These notes are based on specimens trapped or seen by myself in the two periods mentioned or by my host, Mr. Heatley Green, an ardent nature-lover, during the last five years at his summer home at the lake.

Valentine Lake lies in the north central part of Montmorency County, near the intersection of the 45th parallel and the 84th meridian. It is about one mile long and one-half wide, with the major axis extending approximately north and south. Its outlet is a small stream called Kennedy Creek on the east side of the lake, which flows into Black River. The lake is fed by internal springs of a marly nature and by two small brooks. One of them entering the lake on the west side will be called Mouse Brook; the other, Mole Brook, enters the lake at the south end. Perhaps due to the marl springs in the lake, fresh water mussels (*Unio*), much prized as food by some mammals, abound. Pike, bass, sunfish, turtles, crawfish, leeches, water snakes and frogs thrive also. In shallower parts of the lake, yellow and white pond lilies and other aquatic plants are found.

Barring four small summer cottages at the extreme southern end, the lake shore is a lonely forest consisting mainly of balsam fir, tamarack, white cedar, black spruce, hemlock, Norway pine (*Pinus resinosa*), jack pine (*Pinus divaricata*) and an occasional white pine (*Pinus strobus*), the pathetic survivor of hosts of its kind that have vanished before the lumberman's greed. Mixed with these are the quaking aspen, canoe birch, white ash, red maple, alder, and an occasional linden.

Farther back from the lake shore and not more than twenty feet above it lie the so-called pine barrens, marked by jack pine, quaking aspen, scrub oak, a few Norway pines and shad berries (*Amelanchier canadensis*). The soil of the pine barrens is largely sand, acid from decaying oak leaves, and incapable of holding much water; hence the vegetation on the floor consists of little else than brakes, huckleberries, sweet fern and wintergreen. Grasses and legumes that might afford shelter and food to small mammals are lacking. The pine cones and acorns form the main food supply for rodents. Frequent forest fires occur in the pine barrens and must penalize animal life.

Along the moist mucky shores of Mole Brook lie a rich grassy "beaver meadow" and alder thickets, much esteemed by star-nosed moles, woodcock, herons and pitcher-plants. Mouse Brook, on the other hand, flows through a dense swamp of maple, ash, balsam fir, black spruce, canoe birch, tamarack and alder. This forest faces the east and is cool, damp, and shady, with its floor often littered with logs and timber. Unfortunately, it was not prospected until near the end of my stay, when it proved to be a bonanza for small mammals.

The soil itself, nearly pure sand, tends to good drainage and warmth. Considering that Valentine Lake is in the latitude of the northern boundary of New York and Vermont and is within easy reach of northwest winds blowing over icy Lake Superior, the soil factor may be a very potent one in its effect on wild life. Were the southern peninsula of Michigan a land of cold clay soil, would the prairie mole be found there in latitude 45°? Its eastern congener is not found north of southern New York and New England.

The only shrew I could find at Valentine Lake was the plebeian short-tailed shrew. I think there were few places there where the sandy soil was shaded sufficiently to furnish suitable environment for boreal shrews. There are no forested hillsides sloping steeply to the northeast. *Sorex cinereus* may exist there, in sphagnum bogs, as it does in the pine barrens of southern New Jersey. Bats seemed almost lacking at Valentine Lake, although insects and fly-catching birds

were abundant. Perhaps the absence of caves, old buildings or hollow deciduous trees suitable for shelter may account for this. My brother has seen the black bear, beaver, raccoon, marmot, red fox, and a weasel in other sections of Montmorency County. Unless otherwise stated, skins and skulls of the species listed in these notes were preserved. The nomenclature used is that of "List of North American Recent Mammals 1923" by Gerrit S. Miller, Jr.

Scalopus aquaticus machrinus.—Prairie Mole. The familiar ridges of this animal were very conspicuous in the drier parts of the pine barrens on the west side of Mole Creek. Two specimens taken and preserved.

Condylura cristata.—Star-nosed Mole. In the moist mucky soil on the banks of Mole Brook were little mounds of freshly excavated muck, similar to mounds of the pocket gopher of the prairies. Suspecting the presence of moles, I set a number of traps in the runways in the foot of muck which lay between the grass roots and the underground water level. These traps were usually sprung by wads of muck pushed along the runways, presumably by moles. One trap caught a large crawfish. The mole tunnels seemed usually to descend to water but also sometimes had outlets, apparently permanent, on the surface. A trap, set at such an opening leading to a runway in the grass, finally caught a fine star-nosed mole. After a heavy rain the tunnels of this mole were often found flooded by the rising brook. The star-nosed mole impresses one as a very versatile amphibian, with tail, feet and dense fur designed for its work.—In the little community of woodcock, Wilson's snipe, swamp sparrows, crawfish and pitcher plants in which it resides, it is the star muck-raker, literally speaking.

Blarina brevicauda talpoides.—Mole Shrew. Two specimens of this shrew were trapped under matted dead sedges on the banks of Mole Brook. Another was taken under a large decaying log in the coniferous swamp bordering Mouse Brook. This animal seemed restricted to moist and shaded places.

Mustela vison mink.—Northeastern Mink. In July, 1924, my brother saw a mink on the southern shore of the lake. No specimen taken.

Lutra canadensis canadensis.—Canada Otter. My brother and I saw an otter swimming in the lake, near the southern shore, twice in July, 1924, and he had seen it several times earlier in the summer. No specimen taken.

Taxidea taxus taxus.—Badger. In the summer of 1922, I saw a badger skin nailed to my brother's barn. The animal had been killed in the neighborhood. My brother says another was trapped there in November, 1922. None has been seen since and he thinks the animal is becoming very scarce. I did not secure any specimens. The absence of large burrows in the ground at Valentine Lake, suitable for skunks, cottontails, and the like, is very striking to one who has lived in a "ground-hog" country.

Citellus tridecemlineatus tridecemlineatus.—Flag Squirrel. This ground squirrel was the commonest squirrel of the district but was confined to the dry open pine barrens. It has a tendency to become a pest to mankind. Several took up their abode in my brother's garden and enjoyed currants. A number of young chickens were killed in a barn yard one night by some animal, so I was requested to catch a weasel, the rumored villain. Two steel traps baited with meat caught

two of these squirrels instead of a weasel. My brother also thought that ground-nesting birds near his home suffered from these animals. One animal trapped had cheek pouches bulging with 196 large seed pods of the sleepy catchfly (*Silene antirrhina*).

In early July, 1924, young animals were about half grown and still living together. An adult male trapped July 18th was very fat, perhaps in preparation for hibernation. The slinking and secretive ways of this animal, and its gliding through the grass like a snake makes it suffer in comparison with the more attractive chipmunk.

Tamias striatus lysteri.—Northeastern Chipmunk. Two specimens were trapped and several others seen in the scrub oaks. Perhaps acorns were the attraction there. The Valentine Lake chipmunk is presumed to be of this race.

Sciurus hudsonicus loquax.—Southeastern Red Squirrel. In 1922 several were seen in a hemlock grove on the east shore of the lake. A pair also was conspicuous in a large woodpile near a summer cottage. In 1924 I found several feeding on cones of the balsam fir in a coniferous swamp and trapped one. This animal seemed restricted in its distribution to the vicinity of cone-bearing evergreens.

Sciurus carolinensis leucotis.—Northeastern Gray Squirrel. My brother tells me he saw several of these near his camp in 1920, but he has seen none since. None seen by me.

Glaucomys sabrinus macrotis.—Canada Flying Squirrel. One morning, in a mouse trap set in the coniferous swamp bordering Mouse Brook, I found an ovenbird which had foolishly pecked at the bait. It, in turn, had been almost completely eaten by some animal. Hoping to catch a weasel, I set a steel trap baited with a dead mouse at the place, and next day to my surprise found an adult female flying squirrel. This was the only specimen taken.

Peromyscus maniculatus gracilis.—Michigan Mouse. Four specimens have been identified as belonging to this race by Dr. L. R. Dice of the University of Michigan. To a field naturalist, the much larger ears of this species in life as compared with *P. l. noveboracensis*, are noticeable, a difference not so easily marked in the shrunken skins.

Peromyscus leucopus noveboracensis.—Northern White-footed Mouse. Found in pine barrens, eating acorns and pine cones; in coniferous swamp, eating balsam cones; and under linden trees, the seed of which were eaten. The following table indicates average differences of six specimens of this mouse and four specimens of the Michigan mouse, taken at Valentine Lake.

	LENGTH	BODY	TAIL VERTEBRÆ	TAIL PENCIL	RATIO OF TAIL TO BODY	HEIGHT OF EAR ABOVE INNER BASE
	mm.	*mm.*	*mm.*	*mm.*		*mm.*
Peromyscus m. gracilis	169	82	87	6.25	1.06	16
Peromyscus l. noveboracensis	157	84	73	3.5	0.87	13

Synaptomys fatuus.—Lemming Vole. Three specimens of this little vole were caught and preserved in 1924. Back of my brother's camp lies a depression where

a small tract of spruce has been cut off. The sphagnum bog under the spruces has consequently been somewhat dried out but to my surprise I caught two lemming voles, both immature animals, in cavities beneath the moss. The third was caught in a runway through some sedges in the coniferous swamp on the bank of Mouse Brook. Judging from cuttings this animal had been feeding on the sedge, which has been identified for me as *Scirpus lineatus* by Mr. Francis W. Pennell.

There is such a striking difference between the skulls of the Michigan and New Jersey lemming voles in my collection that I consider them distinct species, not races. My Valentine Lake specimens resemble closely others taken by me in central Algoma, Canada.

Evotomys gapperi gapperi.—Red-backed Vole. This species was found only in the forest swamp bordering Mouse Brook, where two adults were trapped in July, 1924. One of these was a female carrying 4 embryos on July 27th. It had 8 mammae: 2 inguinal, 2 abdominal, 4 pectoral. This individual was in the brown phase, the other in the rufous phase, similar to specimens described by Miller from the north shore of Lake Superior.

Microtus pennsylvanicus pennsylvanicus. Meadow Vole. Common in the "beaver meadow" bordering Mole Brook. One also was taken among sedges (*Scirpus*) in forest bordering Mouse Brook.

Ondatra zibethica zibethica.—Northern Muskrat. One seen in the lake in 1924. In 1922 I found them feeding on the seed pods of the yellow pond lily. No specimens taken.

Rattus norvegicus. House Rat. In 1924 I was surprised to find a half-grown individual of this species in a trap set in marsh grass at the southern end of the lake.

Mus musculus.—House Mouse. Several trapped in buildings in 1922.

Zapus hudsonius hudsonius.—Northern Jumping Mouse. In 1924 my young son reported that while frogging in a grassy marsh at southern end of lake he had flushed a red mouse which ran off with a long tail high in the air. Suspecting the presence of *Zapus*, I set a line of traps near the spot and caught a jumping mouse. It was too badly eaten by other animals to be worth preserving and I caught no others.

Napaeozapus insignis frutectanus.—Woodland Jumping Mouse. After setting many traps in vain for this species in possible habitats, I blundered one day upon a little grassy dell in the woodland bordering Mouse Brook. It was the scene of a former small clearing made by lumbermen, now shaded by a second growth of ash, but still leaving a carpet of verdure underneath. It was a charming little forest nook that contained a little Robin Hood's band of wild mice, including a shy little lemming vole and its plebian cousin the Pennsylvania vole, another interesting red-backed vole, piquant white-footed mice, and handsome woodland jumping mice. The last were apparently nocturnal.

Mousehurst-on-Brook, where the summer colony prospered, had shady forest, little green pastures and a cold babbling brook near-by. Such spots were not easily found or forgotten at Valentine Lake and the woodland jumping mouse impressed me as an animal of very restricted habitat. Mr. Francis W. Pennell, of the Philadelphia Academy of Natural Sciences, has kindly identified for me a sedge (*Scirpus lineatus*), *Thalictrum polygamum*, buck-thorn (*Rhamnus alnifolius*),

Asclepias incarnata, and *Eupatorium bruneri* as the most conspicuous plants among which the woodland jumping mice rambled. Two specimens of this mouse were taken and preserved.

Erethizon dorsatum dorsatum.—Canada Porcupine. In 1922, there hung on my brother's barn a skin of this species from an animal recently killed in the neighborhood. I saw none.

Lepus americanus americanus.—Varying Hare. The runways and dung of this species were rather prominent in swampy woodland. In August, 1922, I kicked up several half-grown ones in huckleberry patches in pine barrens. In 1924 an adult animal let me approach within six feet, close enough to see some large ticks on the interior of its ear lobes. No specimens taken.

Sylvilagus floridanus mearnsii.—Prairie Cottontail. My brother tells me that a cottontail visited his garden several years ago and one wintered underneath his cabin in 1922. None seen by me.

Odocoileus virginianus borealis.—Northern Deer. Tracks of this animal were seen on the northern shore of the lake in 1922. No specimens taken.

Ardmore, Pennsylvania.

A NEW LIVE-TRAP FOR FIELD USE

By Robert T. Hatt

Of the several types of traps now in use for obtaining mammals alive and in suitable condition for life-history work and breeding experiments, all prove unsatisfactory for more than a very limited field. It was a desire for a trap that could be taken into the field in numbers, stand rough usage, yet be light, compact, and catch a wide variety of mammals, that led the author to develop the trap here described.

This trap has been made in two sizes for the sake of convenience. The smaller one can be packed inside the larger to economize space in transportation. The smaller size will accommodate animals up to the size of a chipmunk or a kangaroo rat, while the larger one should accommodate a young marmot or a rabbit. In a season's use in Colorado the smaller size caught chipmunks and mice, while the larger took an immature white-tailed jack-rabbit, cottontails, ground squirrels, wood rats and chipmunks. Other animals might have been obtained but settings were made only for these species. The rabbits were taken by placing the entrance of the trap in the mouth of the burrow in which they had taken refuge.

This trap is made entirely of metal and in the form of a box with hardware cloth over one end and the entrance at the other. The bottom

of the box is covered by a false floor which acts as a trigger. The door swings down from above, making hindrance with operation less frequent than in a type with the door closing from the bottom. The all rust-proof metal construction of the trap prevents the weather from interfering with operation, and makes a strong, permanent, compact and light box. Repairs and adjustments become unnecessary. It can not warp out of working order, and rodents can not gnaw their way to freedom.

The metal cloth at the end makes it easy to see the nature of the captive without risking its escape. Bait may be conveniently introduced through the openings. The animal can be easily driven into a sack slipped over the end of the trap by shaking the trap, blowing on the captive, or persuading it with a wire. It is possible that some animals might enter this trap because their passage would not darken the interior, whereas in a trap with a closed end they would not. This feature of the screened end, together with a large open door, insures ease of cleaning either with a brush and soapy water, or by simply placing the trap in running water.

With the pan on the bottom and contact points of the trigger as shown, the trap can be adjusted for the smallest shrew or the largest mammal that might enter. The catch which locks the door is positive in action and exceptionally strong. No animal small enough to get into the trap could force the door or move the lock. The lower edge of the door is turned in, thus keeping complete closure confined to two small points on the sides and to the lock. In this way the door is strengthened, and the tails of animals will be unlikely to be injured or to interfere with the closing of the door.

This type of trap would commend itself for general collecting in the tropics as the animal would not spoil if kept alive and could probably fight off all destructive insects. Many specimens could be thus saved.

In setting the trap a small amount of cotton or other nesting material should be introduced, as many mammals will die overnight in these limited quarters unless they receive this protection. The bait will of course be determined by the locality and the species intended for capture.

CONSTRUCTION

A point of cardinal importance in the construction of this trap is to get the point of contact between the arm head (*C*) and the trigger (*D*) precisely over the pivot of the upright arm (*A*). The four sides of the trap should be cut in one piece and folded in such a manner as to inter-

lock along one of the bottom edges. This joint may then be soldered. The extension of the base to form a support for the lock (*E*) should be folded under itself. It is sufficient to solder the lock to this.

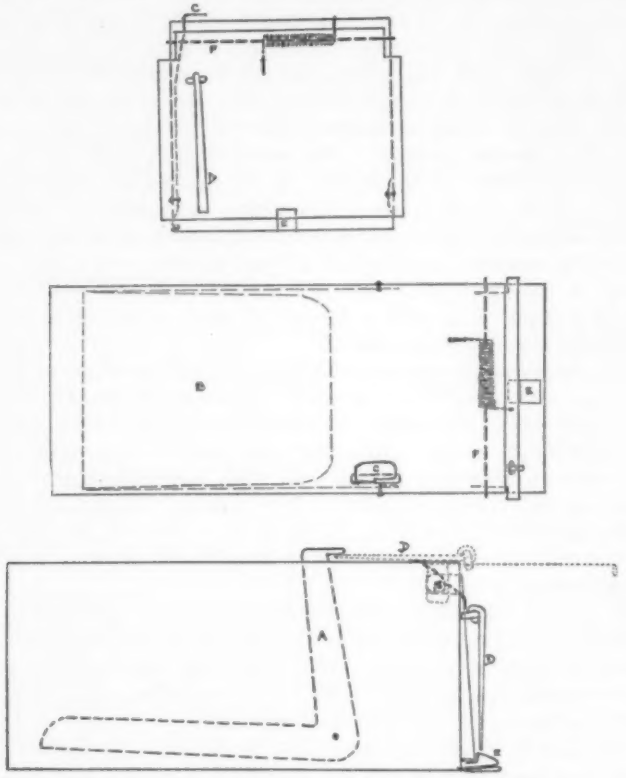

FIG. 1. A TRAP FOR SECURING SMALL MAMMALS ALIVE

The arm (*A*) should be cut in one piece. In the smaller traps it is best to have *A* and *B* all one piece for the sake of strength and simplicity of construction. The larger size may have the pan cut separately and soldered. The hinge rod (*F*) can be soldered in place at both ends or can be looped at one end and soldered at the other. If it becomes necessary to replace the spring it is then easier to remove the rod.

The trigger (*D*) should be hammered flat at its end to broaden and steady the contact surface. The hinge by which it is fastened to the door is simply made by looping the wire, bringing the ends parallel and together, passing them through a hole in the door, spreading the ends and soldering them in place. The springs are easily made by winding the spring wire tightly around a metal rod slightly larger than the rod they are to jacket. The edges of the hardware cloth can be folded in and soldered either to the outside or inside.

The accompanying figure explains the operation of the trap. It is reproduced one quarter the size of the larger trap. Dimensions and materials for the two sizes are given in the summary below:

	SMALL TRAP	LARGE TRAP
Total length	7 inches	12 inches
Height and width	2¼ by 2¼ inches	5 by 5 inches
Weight	8 ounces	36 ounces
Length of body	6½ inches	11 inches
Door	2¾ by 1¾ inches	5¾ by 4½ inches
Pan	3¾ by 2 inches	6 by 4¾ inches
Rod *F* to roof	¼ inch	½ inch
Rod *F*, length	2½ inches	5¼ inches
Pivot of *A* to front of box	1 inch	1½ inch
Lock *E*, width	¼ inch	½ inch
Spring length	1 inch	1½ inch
Body, door, pan, arms	26-gauge galvanized iron	
Hardware cloth	¼-inch mesh	½-inch mesh
Rod *F*, galvanized wire	No. 9	No. 6
Pivot of *A*	Small solid brass rivets	
Trigger *D*, brass wire	No. 9	No. 6
Lock *E*	Spring sheet brass	
Springs, brass spring wire	No. 20	No. 10

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A DEGREASING APPARATUS

By Harley B. Sherman

In preparing osteological and other specimens, it is often necessary to remove grease from them. Degreasing specimens by soaking them in a solvent for grease is not only slow, but also expensive, due to the fact that the solvent loses its usefulness as soon as it has dissolved a considerable amount of grease and must then be replaced. The apparatus described below removes grease rapidly and the solvent can be used repeatedly with only a small loss.

The assembled apparatus is shown in the accompanying figure. It consists of a large tank, which sets in a water-bath and has a conical condenser fitting closely into the top. Inside the tank is a specimen container, for the reception of the object to be degreased, which is held above the bottom of the tank by a support. On one side of the container is a siphon.

In setting up the apparatus for use, the condenser should be removed. The material to be degreased should be placed in the container and enough solvent poured into the container to fill it more than above the top of the siphon. The condenser should then be replaced, a stream of tap water brought into it through the inlet, and the surplus water will siphon off through the outlet. Water should be placed in the water-bath and heat applied. When heated sufficiently, the solvent in the tank will boil. Its vapor will fill the tank, condense on the condenser, and drip into the container. The hot vapor, as well as the condensed solvent, dissolves the grease in the specimen. When the level of the condensed solvent in the container reaches the top of the siphon, the siphon becomes full and the liquid is siphoned off into the bottom of the tank. Inasmuch as the grease boils at a higher temperature than the solvent, only a small part is vaporized, the bulk of it remaining in the bottom of the tank. The solvent, however, continues its degreasing action.

The lower end of the siphon must be curved up so that the liquid may collect there. The heat present in the tank causes the siphon to function poorly without this bend. The inner end of the siphon should be placed close to the bottom of the container, so as to remove as much of the liquid as possible. The lower end should be provided with a screw cap in order to close it when desired. After the degreasing operation is over, the siphon may be closed and heat applied. The solvent will collect in the container, while the grease will remain in the bottom of the tank, from which places each can easily be removed.

The apparatus used by the author is made of copper, with the surfaces, which come in contact with the solvent, nickel-plated. This plating is practically free from the attack of the organic substances which come in contact with it, but it is a good idea to leave the machine clean when not in use.

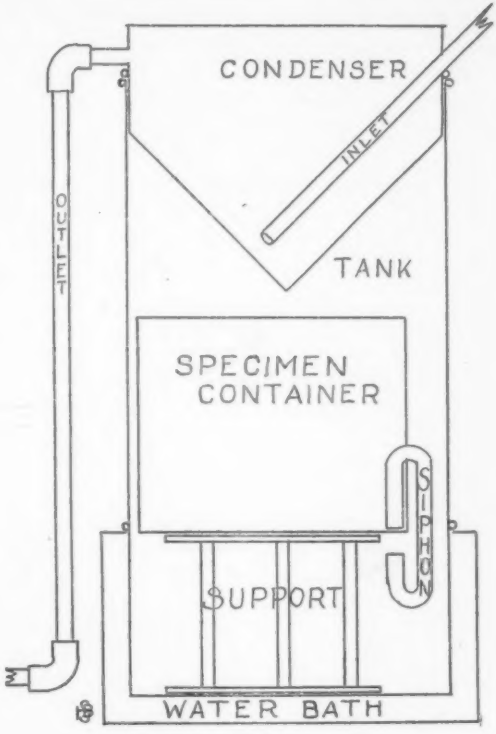

FIG. 1

Specimens, which are damaged by sudden changes in temperature, should be placed in the apparatus before heating, and should remain there until cold, thus insuring a gradual change in temperature. Also, the vapors of most solvents for grease are noxious and are less encountered by the operator if he handles them cold. Carbon tetrachloride is a satisfactory solvent for this type of apparatus, because it

removes grease rapidly, has a low boiling point, and is not inflammable. However, any other solvent may be used, the boiling point of which is below that of water. But if an inflammable solvent is used, heat should be from some source other than a flame.

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MIGRATION ROUTES OF ELK IN YELLOWSTONE NATIONAL PARK

By M. P. Skinner

Since the Yellowstone elk originally spent the winter in the foothills and on the plains, and the summer in the mountains, their instinct to migrate is old and long established. Because all the lower land is now occupied by ranches and crossed by ranch fences the elk can no longer leave the mountains and descend to the plains as they formerly did, but within the Yellowstone National Park and the surrounding national forests and game reserves they still make regular migrations from the snowy higher ranges to the comparatively snow-free northern section of the park and to the lowest valleys of all the reservations. Each spring they return again to the mountains, mostly inside the Yellowstone Park.

Elk are grass-eaters, or grazing animals, and food was the primary cause for the inception of this migration, with cold weather and snow as indirect agents because both the elks' acquired instinct and their experience told them snow would cover their food and that snow and cold would come together. I have seen a good many instances which show that these indirect causes are still operative. Even an unseasonable snowstorm in summer will drive the elk down to lower valleys. Such was the case on July 20, 1924, when snow on the mountain tops drove five elk down to the Gibbon River at about 7000 feet above sea level near Gibbon Junction. One year when I was in the upper Yellowstone Valley in October, the first snowstorm drove every elk out of the valley; and where they had been numerous during early October not a single one was left the next day after the storm. On September 14, 1917, elk suddenly appeared in Snow Pass with the beginning of the first snowstorm. The snow of October 23, 1919, started every elk to moving out of the Upper Geyser Basin, and even a few days of cold

weather without snow started the migration near Cold Spring on September 19 of that year.

In summer in the Yellowstone National Park, almost all of the elk are on the higher mountains and in the forests between altitudes of 8000

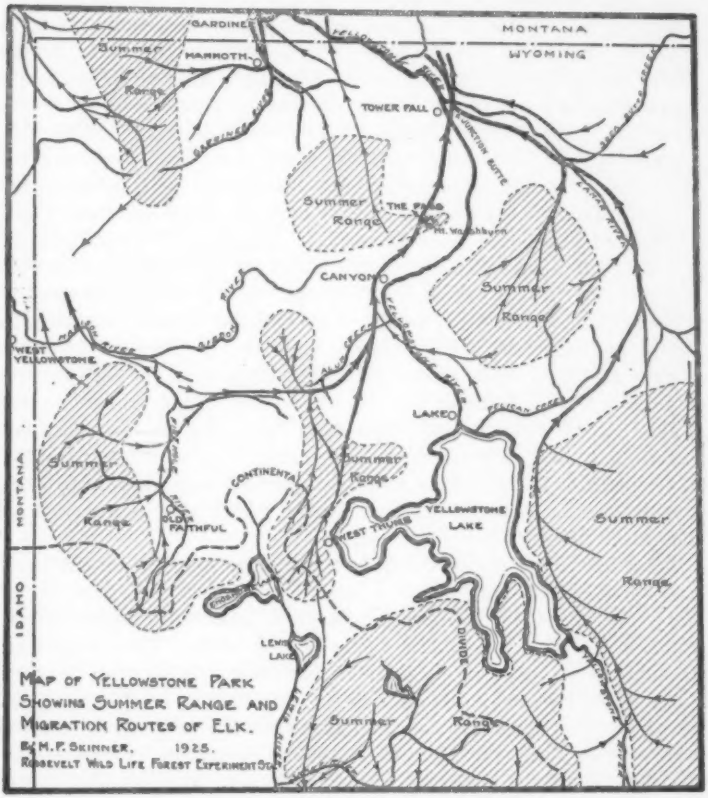

FIG. 1. MIGRATION ROUTES OF ELK

feet and timberline at 9500 feet. But there are many exceptions: I have known one or two elk to stay all summer in an aspen grove at 6500 feet, only a short distance above Mammoth; on Rescue Creek at 6500 feet on July 24, 1919, I saw several; also in the lower Blacktail

Valley at 6300 feet on July 25, 1917; and again I found two elk along the Mesa Trail at 7000 feet on August 8, 1921. But these are all sporadic instances and do not affect the general statement that the elk are naturally higher up at that season.

In winter the elk are mostly on the low northern and northwestern valleys below 6500 feet. (In this paper I am discussing only the northern herd of elk and not the Jackson Hole herd, for the elk of Jackson Hole range mostly outside the Yellowstone National Park.) But again there are exceptions: A few elk stay all winter near the formations at Norris, Biscuit Basin, Sulphur Mountain, and Pelican Hot Springs because they secure food where the warm earth at these points melts the snow and gives the animals a chance to get a little forage.

The grasslands between the highest and the lowest extremes of altitudinal range are used in spring and fall. The best of the spring ranges are the Slough Creek Valley, Lamar Valley, Specimen Ridge, Blacktail Valley, and Gibbon Meadow. The best of the autumn ranges are Pelican Valley, Hayden Valley, Lower Geyser Basin, Swan Lake Basin, and Blacktail Valley. About September 1, when the first snow flurries and hard frosts occur, the first movements in the elk herds are noticed. During summer the elk are in the forests about Hayden Valley but the last week of August they begin to come out, and I saw several scattered along the East Yellowstone Trail on August 26, 1917. On September 3, 1917, these Hayden Valley elk began appearing along the old freight road behind the Canyon Hotel, and moving toward Dunraven-Mount Washburn Pass.

Near the Geyser Basins the earliest movement noted was at the north end of the Mesa Trail where I found fresh tracks of moving elk on September 21, 1917, and a month later the elk were common farther south in the forests about the Upper Geyser Basin. Then they began coming out on the open meadows at this basin. On October 20, 1919, there were nineteen elk out on these meadows in the early morning but, as on previous days, they all disappeared into the timber at sunrise or soon after. Then they began to appear during daytime also. On October 23, 1920, I discovered the elk were moving down the Firehole Valley from the Upper Geyser Basin toward the Fountain Meadows in the Lower Geyser Basin; and, although a few elk remained to winter near Biscuit Basin, all the others were already below Excelsior Geyser, four miles from the Upper Geyser Basin, and still moving on. This led to the discovery of the elk migration routes in this section. In early October the elk that have summered on the forested Summit Lake

Plateau, the southern part of Madison Plateau, and the forested upper Firehole Valley above Keppler Cascades, move down through the Upper Geyser Basin to the Lower Geyser Basin, then turn sharply east up the valley of Nez Percé Creek, up and over Mary's Mountain, and down through Hayden Valley to join the herds already moving there. The elk on the northern part of Madison Plateau and those above Mesa Trail move down the Madison River to the west boundary and winter on the open prairies north of the Madison River and in the nearby groves of pine and aspen.

Meanwhile the elk summering about Yellowstone Lake move north by two routes: those on the extreme east mostly go up in the Pelican Valley and cross to the Lamar Valley and down, but a few from the lower Pelican Valley go north down the Yellowstone River to join the Hayden Valley herd. Some of the elk west of Yellowstone Lake near West Thumb and south thereof go south across the continental divide toward Snake River and Jackson Hole. It should be observed that all along the continental divide, at least inside Yellowstone National Park, there is an interchange between the elk normally wintering in the northern part of the Yellowstone and those wintering south near Jackson Hole. I do not know just how great this interchange is but I do know that hundreds of elk cross the divide going in both directions for I have seen them do it. I do not know whether all the elk coming from either direction retrace their steps or not, but I believe that there are some that do not. The remainder of the elk from west of Yellowstone Lake go north to the narrow, shallow valley of Arnica Creek and up it to the low divide at the head of Trout Creek and then down the latter creek into Hayden Valley.

As already stated the elk about Hayden Valley begin moving in September and are soon out into the open valley moving toward the mouth of Alum Creek, which they cross and then turn north, passing one mile west of Canyon Junction and on to the valley of Cascade Creek. From this point they move on slowly to the passes over the Mount Washburn Range near Observation Peak, Hedges Peak, Dunraven Peak, and Mount Washburn, although by far the greater number use the two passes between Dunraven Peak and Mount Washburn. In one of these passes is the automobile road, while the other pass is a little farther east. Since the park tourist season is over before the elk reach this point, there is no auto traffic there then to interfere with and frighten the elk. These two passes, and also the others, are used throughout late September, October, and early November, by an in-

creasing throng culminating late in October, the elk from Hayden Valley augmented by those coming from Lower Geyser Basin, lower Pelican Valley, and Arnica Creek. Probably one-third of all the elk in the northern herd go through this Mount Washburn pass each spring and each autumn. During the autumn of 1917 at least eight thousand elk crossed the same pass as that used by summer automobiles, a minor instance of the way that modern auto travel follows the old game migration routes, especially through mountain passes. Even as late in the season as the middle of November, if the migration has not been hurried by early heavy snows, the elk are still streaming to this pass, as was the case on November 14, 1922, when I went through it myself.

Normally this fall migration is made in small groups. For instance, I crossed the Mount Washburn pass in the afternoon of October 27, 1922, and there saw five groups of elk with 1, 14, 4, 6, and 5 in each respective group, scattered along the elk trail for three miles. But if heavy snows force the elk, they may all migrate in the fall, as they habitually do in the spring, in long strings moving in single file at the rate of about two miles an hour. It will be noticed that in following this route the elk near Summit Lake leave a high divide and not only go down to a lower elevation but also climb up and across the two divides at Mary's Mountain and Mount Washburn, each higher than the starting point, before they finally reach the winter range. From the passes on Mount Washburn the elk move down the slopes toward the Tower Falls ford on the Yellowstone River, to Junction Butte, and on to the Hellroaring wintering ground, if they care to go so far. These elk ford the Yellowstone, for this stream is no barrier to them, but is crossed at many points. Many elk do not go this far but remain on the northern slopes of Mount Washburn all winter.

Early in October the elk coming across Mirror Plateau from Pelican Valley, augmented by those that have summered on Mirror Plateau and those coming down the upper Lamar Valley, begin to reach the Buffalo Ranch. On October 4, 1915, I counted 538 elk coming down the hills in the late afternoon toward the Buffalo Ranch. From this point the elk move on down the Lamar Valley and on toward Junction Butte to the west.

On November 1, 1917, I found the elk which had come down the Lamar valley and from Mount Washburn very numerous about Junction Butte. In mild winters elk winter about Junction Butte, but otherwise they move down the Yellowstone River to the Hellroaring wintering ground and even beyond and out of the park. Even during mild winters there are large numbers of elk on the Hellroaring slopes.

While all these movements are going on in the sections of the park which we have considered, other elk converge on Mammoth and the Gardiner Valley from three directions. A few of the animals that have summered in and around the Gallatin Mountains move across Swan Lake Basin and down through Snow Pass, although the majority of the Gallatin elk go down the Gallatin River toward the northwestern corner of the park and beyond. The elk that have summered on the Blacktail Deer Range move across Blacktail Valley and down toward Mammoth via Lava Creek and Undine Falls. But a large share of these Blacktail Deer Range elk move from Lava Creek over Mount Everts and toward Gardiner via Rescue Creek and the Turkeypen Trail; some, however, move down Blacktail Deer Creek, ford Yellowstone River, and go north across the northern boundary of the park. In mild winters these elk winter in the lower Blacktail Valley and on Mount Everts, and a few about Mammoth.

Early in September the movement toward Mammoth reaches Snow Pass and is down to Mammoth by the end of the month, as on September 26, 1921. The first arrivals among these elk are timid and move about at night, but early in October they come out on the plaza at Mammoth Hot Springs, and in a few days become bold enough to come out on the plaza by day, as noted on October 23, 1922. From this time on, the elk at Mammoth steadily become tamer and less suspicious and by the middle of November they are frequent among the numerous buildings at that point. The attraction at Mammoth is the grass on the lawns and the hay on the artificial plaza.

Probably the longest distance traveled by a Yellowstone elk in normal years is about eighty miles, covered in about fifty days. The movement is not a steady one but ebbs and flows with the changes of weather.

Since the more or less steady winds blow the snow from certain high open slopes on the bare mountain ridges, some elk winter in such localities in spite of the bitter cold. On November 10, 1920, I found a bull elk wintering on the warm, southern-exposed, bare hillsides above Snow Pass. And later that same winter I found about twenty elk, mostly bulls, wintering on the southern slopes of Bunsen Peak and across on Terrace Mountain at about 7500 to 8500 feet above sea level. This band I watched rather closely. They kept to this elevated range all winter and came through in good shape on this combination of southern slopes and wind-swept grassy ridges.

The Slough Creek Valley is not normally a wintering ground for elk,

but of late years the artificial feeding of hay there has attracted and held them. Neither were the flats near Gardiner, Montana, normally elk wintering grounds until artificial feeding drew them there. But it is interesting to observe how quickly elk find out that hay is to be obtained. It argues for an intellect and method of intercommunication higher than is ordinarily accorded to this animal.

All through the winter, whenever a thaw occurs or the snow on the ground melts for any reason, the elk work up the mountains as high as they can. As spring approaches their efforts are redoubled. On March 2, 1918, I noted that elk were beginning to scatter from the hay-feeding grounds; on March 5, 1914, elk tracks extended south above Mammoth Hot Springs for one mile; on March 6, 1914, elk began to work up through Snow Pass, but a snowstorm on March 25 drove them down again, although a week later they were again on the bare ridges as high as they could get and as far as the bare spots extended.

The spring migration reverses over the same routes followed in the autumn, but now the elk string out in long single-file herds, often of great numbers, and led by the strongest, most daring and most resourceful of the *females*. On February 14, 1921, I noted that all the elk had left the lowest ground near Gardiner rather earlier than usual and on February 24 I found two small bands already well started up the Turkeypen Trail. March 1 and 2 of the same year, long files of elk passed Mammoth going towards Undine Falls and Lava Creek. On March 11, 1921, I encountered a file of 233 elk near Undine Falls and another band of 267 on the Blacktail Valley above Undine Falls. On March 4, 1915, I saw a big band stringing out up Blacktail Deer Creek and the next day an even larger herd going up past Undine Falls. In early April the elk are very numerous in the upper Blacktail Valley for this is pre-eminently a spring range although used also as a winter range in mild years. About the middle of April there is a small reverse current of elk going down to the lowest elevations for the fresh spring grass that appears there first, but this does not materially affect the main movement that goes steadily upward. Soon after April 1, the elk start from the Hellroaring slopes and work up toward Junction Butte, and the Lamar Valley about the Buffalo Ranch. This, like the Blacktail Valley, is naturally a spring range for elk although used in winter during mild years. Like in the Blacktail, the snow is too heavy in the Lamar Valley for winter use by elk during ordinary years.

Every year there are many of the pregnant elk that remain at the lowest levels, even as low as 5500 feet altitude, until June to have their

calves, and many other cows return from higher levels to the lowlands for the same purpose. As soon as the calves can travel, or when they are about two weeks old, the mother elk and the calves join the migration all along the many routes. Since May and June are also the months for the Lamar River to be in flood there is difficulty in crossing that river above the Buffalo Ranch, but the elk eventually accomplish it without any great mortality in drowned calves. In early June, the earliest elk are back again on the lowest of the summer ranges, although the migration continues a month longer before the last elk arrives.

Since the start of the fall migration is in September when the bulls are getting ready for mating, they start with the cows, but they do not all of them travel all the way nor as far as the cows usually do. Hence it is quite natural that the bulls having a shorter distance to return and being unimpeded by calves, should be the early arrivals on the summer ranges. But I want to emphasize that it is the cows that lead the bands both on migration and at other times. In summer, the cows, calves and yearlings are together, and naturally the older animals, the cows, lead. The bands of elk do not have any formal election or appointment of leaders, but arrive at the result by a process of elimination. The elk that the others trust most, the one safest to follow and that knows the best pastures and routes, is the leader. If any members of the band do not trust the leader there is nothing compelling them to remain in the band, they can go the other way. But the result is that the band that is left has unanimously adopted its leader. And it is always a cow elk that is the leader of the band; the big bull may *drive* but he does not *lead*. I have seen a band of elk following the same leading cow come to a division of the ways. Occasionally, as I have said, the band will split, but usually the leading cow makes her choice and goes on. If there is another cow that thinks the other route better, she may turn into it. Then the other elk as they come up follow the one they choose. Should the majority follow the first cow, as they usually do, she keeps on as leader, and of those following the new would-be leader first one elk and then another will desert her and turn back to follow the old. Eventually the would-be leader will also return to her former allegiance. But should the majority of the band favor the new leader, the same process is reversed until even the former leader accepts the new condition and takes her place as a follower. This process of elimination is always acting, and the leading cow's popularity is frequently tested, so that the position is a fluid one. In the hundreds of bands I have watched it was always a cow that led, although bulls

were frequently present. The only exception I have ever noted was on Mount Washburn on September 29, 1917, when of a pair of elk going up the bull was leader. On the other hand, on July 12, 1917, I met a band of elk in Hayden Valley numbering sixty-two, mostly bulls, but when they moved off in alarm they were led by a cow.

In the autumn when the bulls are forming their harems, it is still the cows that lead while the bull is in the rear apparently driving up the stragglers. In case of danger it is he who urges, and, if necessary, drives the band forward, but the *leadership* and choice of where to go is taken by the most trusted female as already related. It is not always an elderly cow that leads; although it is likely to be, the rule is not invariable.

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A LITTLE-KNOWN VOLE FROM THE YAMAL PENINSULA

By S. I. Ognev

In my article, "On the new and hardly known species of Russian Rodentia" (Bulletin de la Société des Naturalistes de Moscou, 1918–1922, n. s., vol. 31, p. 83–84), I published a brief description of a very interesting vole, *Stenocranius major* Ognev, from the Yamal[1] Peninsula, Siberia. In the present article I shall give a more complete description of this interesting animal.

The six specimens of *Stenocranius major* were obtained by B. M. Shitkov during his expedition in the Yamal in 1908. The type is no. 4097, collection Zoological Museum, Moscow University, ♂, June 10, 1908, Lake Nei-tö, lat. 70°N. The remaining material consists of no. 4102, ♂, July 13, 1908, from the seacoast near the mouth of Mórda River;[2] no. 4100, ♂, June 25, 1908, confluence of rivers Mórda and So-jagá; no. 4096, ♀, June 8, 1908, Lake Nei-tö, lat. 70°N; no. 4098, ♂, July 13, 1908, valley of Mórda River, the tumulus Limbí-Södé (from the nest of *Archibuteo lagopus*); no. 4095, ♂, July 23, 1908, Jurubei River.

[1] Yalmal, Jalmal, or Samoyedes Peninsula on most maps. *(Editor.)*

[2] The precise designation of these localities may be seen on the detailed map in the interesting work of B. M. Shitkov, The Yamal Peninsula, Memoires Imp. Geog. Soc., vol. 49, St. Petersburg, 1913.

General characteristics of the skull.—The skull is long, comparatively narrow, with relatively not broad zygomatic width, narrow interorbital constriction, the breadth of which in the old specimens is less than 3 mm. In the region of the hard palate (in front of the first molar teeth) the skull is high, comparative to the occipital region. The lower jaw is large and massive.

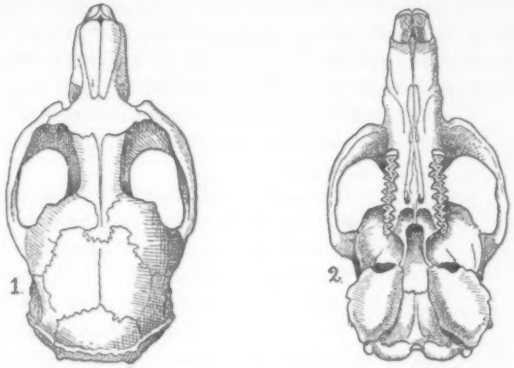

FIG. 1. SKULL OF STENOCRANIUS MAJOR. SUPERIOR VIEW, 2 ×
FIG. 2. SKULL OF STENOCRANIUS MAJOR. INFERIOR VIEW, 2 ×

By its structural peculiarities the skull of *Stenocranius major* differs widely from the remaining voles of the genus. Namely, the skull of this species is much larger and more massive than that of the proximate forms. As compared with the skull of *Stenocranius gregalis slowzowi*

FIG. 3. SKULL OF STENOCRANIUS MAJOR. LATERAL VIEW, 2 ×
FIG. 4. MANDIBLE OF STENOCRANIUS MAJOR. LATERAL VIEW, 2 ×

the one of *S. major* is much longer, has zygomatic arches wider, tooth-rows greater, and the first incisivi are especially strong. From *S. buturlini*, the vole from Yamal differs in a larger skull, much wider space of the zygoma, and comparatively less swelling in the occipital region in consequence of which the parietal bones are less concave. The

difference from the *S. kossogolicus* is also very apparent, the skull of *S. major* being greater, but the bullæ osseæ compared with the general dimensions of the skull less.

In comparison with the *Microtus arvalis* the skull of *Stenocranius major* is longer. Precisely, the length of the occipital capsula of the adult *S. major* is 15.2 mm. (measuring from the back angle of the interorbital constriction to the upper border of the occipital bone). In old specimens of *M. arvalis* these dimensions are 13.2 to 14.2 mm. Comparing the relation between the spaces of the zygomatic arches and the length of the skull of *S. major* and *M. arvalis* we note that the Yamal vole's are narrower; the interorbital constriction is also more compressed comparatively to that of *M. arvalis*.

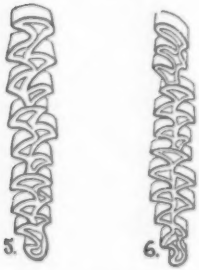

FIG. 5. ENAMEL PATTERN OF UPPER MOLARS OF STENOCRANIUS MAJOR. 6 ×

FIG. 6. ENAMEL PATTERN OF LOWER MOLARS OF STENOCRANIUS MAJOR. 6 ×

The teeth of *Stenocranius major* are in general like those of *Stenocranius g. slowzowi*, but much larger; M^3 with six enamel loops, and three angles on the external side and four on the inner; M_1 with 9 loops, the enamel pattern of this tooth being much like that of *S. g. slowzowi*. The incisors in both jaws are very large. The length of the upper incisor (from the anterior border of the alveola to the tip of the tooth) in an adult specimen is 6.7 mm.; the length of the lower incisor is 9.1 mm. In *S. g. slowzowi* the same dimensions are 4.7 and 7.8 mm.

Age variability of the skull.—The occipital part of the skull in a young *Stenocranius major* is very great; it is much longer than that of an old specimen and strikingly exceeds the anterior half of the skull. For example, the occipital region of the young *S. major* (from the inner angle of the interorbital constriction to upper border of the occipital bone) is 14.8 mm., the anterior (from the same point of the interorbital constriction to the upper border of the alveola of the incisors) being only 9.6 mm. In the adult *S. major* these dimensions are 15.2 and 16 mm.; in the young *M. arvalis*, 14.1 and 10.5 mm.

The occipital region of the skull of the young vole from Yamal is very convex. Regarding the profile of the skull we notice a convexity in the region of contact of the frontal and parietal bones, therefore in the middle of the upper part of the skull outline. The interorbital space in the young vole is much greater than the same in the old speci-

men, it being in width 3.8 mm. Therefore, a very characteristic peculiarity of the cranial structure is the narrowness of the interorbital constriction which is reached by slow graduation from the young age of the individual to its maturity, and finally to old age. The orbit of the young *S. major* is much smaller than that of the old one and the nasal bones comparatively shorter. The bullæ osseæ are more convex than in the young *Microtus arvalis*.

TABLE 1

Measurements of Stenocranius major

MEASUREMENT	NO. 4097, ♂	NO. 4102, ♂	NO. 4100, ♂	NO. 4096, ♀	NO. 4098, ♂	NO. 4095, ♂
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Head and body	120	103.5	129	99.2	96	90.2
Tail (with terminal hairs)	30.8	25.7	27.2	27.2	28.2	24.8
Terminal hairs of tail	16.5	12.1	9	5.9	6.2	5.5
Hind foot (with claws)	1.9	17.2	18.5	16.9	19.3	17.9
Ear	11.9	11	11.7	11.9	11	11.2
Total length of skull	30.1			27.3	26.7	26.2
Condylobasal length	30.2			27.2	26.5	25.9
Basal length	28.2			25.7	24.7	23.7
Length of *ossa nasalia*	8.8			8.2	7.8	7.2
Upper molar row	7.4			7.1	6.6	6.2
Interoribital constriction	2.9			3.1	3.2	3.4
Breadth of zygoma	16.3			15.1	13.7	13.5
Breadth of the skull capsula	12.3±			12	11.8	11.3
Height of skull in region of bullæ	8.9			9.3	9.4	9.2
Height of skull in palatal region from molar teeth	8.3			7.3	7.2	7.6
Lower molar row	7.6			7	6.2	5.8

Color.—The general tint of the fur is a very dull pale-gray. On the flanks are conspicuously yellow shades; the belly and feet are white. The fur is very thick and soft; the length of the middle back hair is 18 to 19 mm.

The details of the coloring are as follows: The hairs on the back at their bases are of a dark slaty brown color for a considerable length; the terminal parts are of a yellowish tint; the tips are brownish gray. In consequence of this the general color is comparatively dull. The very short tail is pale yellow on its upper side (particularly on the basal half), and on its under side white; the flanks, belly, and feet are pure white; the bases of the hairs of the belly are slaty brown. The claws are white. The vibrissæ are composed of a mixture of brown and whitish hairs.

University Zoological Museum, Moscow, Russia.

GENERAL NOTES

THE VIRGINIA OPOSSUM IN MASSACHUSETTS AND NEW HAMPSHIRE

On the evening of February 25, 1925, Mr. James. H. Goddard, a neighbor of mine in Newton Centre, Massachusetts, noticing the continued barking of a dog in the woods just back of his house, investigated the source of the disturbance and to his surprise found a neighbor's dog worrying a large fat opossum. The opossum was holding his own, scorning to climb a tree, when its attention was diverted by Mr. Goddard's approach, and the dog took advantage of the opening for which he had been looking. The opossum, through the generosity of Mr. Goddard, now graces the collection of the Boston Society of Natural History.

The animal, a male, was 30 inches long and, except for its face, of a much darker color than any that I have ever seen either in the series of the Museum of Comparative Zoology or elsewhere; nearest in hue to the blackish brown No. 2, plate 45 of Ridgway's "Color Standards and Nomenclature," but more glossy. If I were to describe the color independently, I would call it a rich, dark, glossy, chocolate brown interspersed with a few long white hairs.

On December 10, 1915, at Warner, New Hampshire, Mr. J. D. Smith, of the Boston Society of Natural History, captured an opossum in a No. 4 fox trap. Dr. Glover M. Allen, whom I consulted in the matter, tells me he believes this to be the first record for New Hampshire. This animal was of the ordinary light-colored type, unsexed, and was afterwards disposed of by Mr. Smith, who at the time did not appreciate its rarity in that vicinity.—Fred H. Kennard, *Newton Centre, Mass.*

FOOD OF THE CALIFORNIA LEAF-NOSED BAT

On May 18, 1924, I visited a colony of California leaf-nosed bats (*Macrotus californicus*), in an abandoned mine shaft, one mile north of Potholes, Imperial County, California, with the object of collecting a small series of specimens for the Natural History Museum, San Diego, California. This colony had been visited on two other occasions, in the interests of Donald R. Dickey of Pasadena, so it was not new to me, although the population had increased considerably since the former visits. The colony, at this date, contained about 500 individuals, all of which were roosting in a semi-darkened stope, which extended upward toward the surface of the ground, where a large cave-in admitted all but direct sunlight. At first approach most of the bats flushed, going to the deeper levels of the mine, although I was able to collect a dozen specimens with three sweeps of a butterfly net. All specimens taken were females in a pregnant condition, the fetuses proving upon examination to be of equal size, 30 mm. in length. Their development would indicate that the young were soon to be born.

After the bats had been flushed, I examined, in the good light entering from the surface, the great accumulation of fecal matter piled up by generations of the bats. My attention was first attracted by numerous insect wings scattered about and I gathered a small gun-shell box full of various objects to be identified later upon my return to San Diego. This was turned over to the Museum's entomologist, W. S. Wright, to whom I am indebted for the following determinations: tegmina of *Schistocera* sp., grasshopper, (part of wing); leaf of *Salix* sp., willow; tegmina of *Trimerotropis* sp., grasshopper, (eight right and four left); hind wings of *Trimer-*

otropis sp., grasshopper, (19 hind wings); wings of *Celerio lineata*, sphinx moth, (six left and eight right); wings of *Smerinthus cerisyi*, sphinx moth, (two hind wings and one front wing); wing of *Peridroma margaritosa*, noctuid moth; wings of a cossid moth, (one hind wing and one front wing); wings and partly eaten body of *Cicada*, harvest fly, (one complete, two left wings, one right wing); elytra of *Melloidæ* sp., beetle; apparently the gorged viscera of some large insect, perhaps those of grasshoppers, because dissection of two specimens found them tightly packed with vegetable matter.

As is well known, *Macrotus californicus* is a very late-flying bat and hence its feeding grounds are little known. The presence of willow leaves under the roosts would indicate that the bats frequent river bottoms. It is possible that some of their food, such as the grasshoppers and harvest flies, which are diurnal insects, were taken from their resting places on the willow trees, where they were seized, leaf and all, by the bat and then carried to the roost to be devoured.—LAURENCE M. HUEY, *Natural History Museum, San Diego, California.*

COUGAR KILLS A BOY

The cougar, or mountain lion, of America has seldom been a menace to man, like the lions of Africa and India. Many stories have been written of cougars attacking people. Very few are authentic. It is always safe, however, to remember that the cougar is such a big and powerful cat that one could kill an unarmed person if so inclined.

An authentic case of a cougar killing a 13-year-old boy occurred about 12 miles southwest of Okanogan, Washington, on December 17, 1924. Mr. Harris, supervisor of Chelan National Forest, Okanogan, Wash., has furnished me with a statement, signed by R. L. Nash, with whom the boy, James Fehlhaber, was staying at the time he was killed.

Every effort was made to track and kill this cougar, but it was not until January 9, 1925, that word was received that one was killed about 8 miles east of Winthrop and some 20 miles northwest of the place where the boy was killed, with data agreeing closely with the idea previously formed regarding the animal. It was an old female, with teeth broken and claws so worn that it could not injure the dogs. The feet were bloody, indicating that the animal had traveled a long way. It did not take to a tree when pursued by two dogs, showing probably that it was unable to do so because of its poor condition. It was comparatively small and much emaciated. The stomach of the animal was sent on to Washington for examination.

Mr. Nash's, statement, dated January 8, 1925, follows:

"The place of attack was on an old trail leading through a canyon, little used in recent years. It was about three-eighth mile from the main-traveled road leading from Brewster to Olema, a mail route. The nearest inhabited house is about one-half mile distant to the north and one mile distant to the south; a number of abandoned farms are near by. The Chelan-Okanogan Highway is about two and one-half miles east. Location is in Section 23, T. 32, R. 24, E. M. The canyon mentioned is about one mile long cutting across a loop in the main road. Brewster is thirteen miles south. Malotte is five miles northeast. To the west are steep rough mountains. To the east is more or less open land with farms largely deserted.

"The spot of attack was just outside a thicket of small pines, in open country under old timber. The opening was about 300 feet across.

"The boy, James Fehlhaber, thirteen years old, of small stature, left Rob't Nash's house at 11:30 a.m., Wednesday, December 17. It would take him about fifteen minutes to reach the place of attack, as Mr. Nash followed his tracks and saw just where he went. Hence he must have been killed at very close to 11:45 a.m.

"It was evident that the cougar came down from the steep hillside, quartering behind the boy. He seemed to make a leap of about 10 feet from the cover of the brush, and struck the boy unawares. There was much blood where he fell. Then he was probably dragged but may have crawled some five feet away to where more blood was spilled and the killing finished. Then the cougar dragged the body some 75 feet to the base of the cliff at a place concealed by small trees, brush, and rocks. It looks as if it was here that the body was partly eaten.

"The body was partly disemboweled. A spot about as big as one's hand was eaten from one thigh. Both hands were gone, apparently eaten clean to the wrists, bones and all. The skin and flesh were eaten clean from the skull, face, and neck, no trace of hair or hide remaining. From the position of the boy's gloves his hands were probably bare, so that, except for the thigh, the cougar ate mainly the parts not covered by clothing. The bowels were strewn around, bitten off, and no doubt partly eaten.

"The body was found by Mr. Kelly and Mr. Nash about ten o'clock the same evening. The boy's coat had been removed, probably pulled off by brush and rocks, about 25 feet from the body. Mr. Nash placed it over the skull. It was covered with froth, saliva, and blood, but not torn. The body was moved an hour or so later, without the coat, probably having been pulled out from under it. Next morning the coat was found in a lair the cougar had been using, about 200 feet away from where the body was found, up in the rocks. It was torn to shreds. It is clear to Mr. Nash that the cougar returned after the body was moved and carried the coat to his lair; although Mr. Kelly was of the opinion that it took the coat before the body was moved. Tracks of the animal that morning were on top of the man tracks, which supports Mr. Nash's view. In any event the cougar returned and took the coat. Very likely he was in his lair watching the action taken in removing the body." ((Signed) R. L. Nash.)

Since the above account was written another cougar was killed on January 20th, 1925, about 4 miles from the point where the Fehlhaber boy was attacked. A rancher named Charles Garratt killed this animal and Mr. F. J. Clifford of Brewster, Washington, bought the carcass and found a bunch of hair, bones and other remains in the stomach. Portions of the stomach contents were sent to the University of California and the Washington State College at Pullman. The stomach itself and the rest of the contents were sent to the Smithsonian Institution. This material was in turn referred to the United States Bureau of Biological Survey. The report on the stomach contents showed conclusively that the hair bore close resemblance to that of the boy's hair picked up in the snow where the killing took place. The evidence was even more conclusive when small pieces of clothing, similar to that worn by the boy, were found in the matted hair. Mr. F. S. Hall of Seattle, Washington, gives a very complete account of the tragedy in the May, 1925, issue of the Murrelet, which is the

official bulletin of the Pacific Northwest Bird and Mammal Society.—WILLIAM L. FINLEY, *Jennings Lodge, Oregon.*

NOTES ON NEW ENGLAND CARNIVORES

In studying the trails of wild cats here in southern New Hampshire, I have noticed that these mammals make use of ant hills just as Seton mentions their doing in Nova Scotia, but I failed to grasp the significance of it until I read his article (Journ. Mamm., vol. 6, p. 48, February, 1925). When the snow is not very deep, they paw it away before depositing their dung there.

There are rumors of a lone panther seen now and again in northern New England. A reward has been offered for its capture. I wish, instead, some means had been taken for its protection. To kill an individual of any rare species I consider an unpardonable crime. I believe that it is possible that there may be a lone panther or two roaming the woods to the north of us. Thirty years ago, the rumor of a wild cat or deer being seen anywhere in southern New Hampshire was hooted at. Now both species are common enough wherever there are woods for their cover.

I recall telling an old trapper that I had found tracks which I was sure were otter tracks along Exeter River and Old River in Hampton Falls. He replied that he had trapped minks and muskrats along both streams all his life, and if ever an otter had been along there he guessed he should have known it. Within the next two years I trapped four otters, shot one which I lost, and saw others within two miles of where that old trapper lived. He was a keener observer than I have ever been but, believing otters to be extinct here, he failed to see their sign.—WILLIAM EVERETT CRAM, *Hampton Falls, New Hampshire.*

A NOTE ON THE STELLER SEA LION

While studying birds on the shore at Pacific Grove, California, I noticed on February 22, 1925, what appeared to be a raft of kelp and wreckage, floating in the waves near some rocks. On examination with eight power prismatic binoculars, I saw that the raft was made up of a number of Steller Sea Lions (*Eumetopias jubata*) so close together that they covered a surface of not more than 12 feet square. Their heads would appear above the water occasionally, but whether all at any one time or not I could not determine. There appeared to be about fifteen females and one male, or probably two males. From time to time two heads would rise together closely approximated, fact to face, as I have seen in the actions of the harbor seal (*Phoca vitulina*) on the Massachusetts coast, when I supposed they were copulating. Occasionally the back flipper and tail would be waved in the mass of seals.

During the whole time of my observation, one hour and twenty minutes, one fore flipper was held above water and from time to time several females would push their heads over the body close to the flipper. I could not be sure, in the tangled mass of animals, whether I saw the head belonging to the owner of this waved flipper or not. At one time I supposed that the sea-lion whose flipper showed in this way was dead, but after seeing the flipper move steadily around the periphery of the raft, I concluded that the animal was alive. During the last twenty minutes of my watch, a second flipper in another part of the raft moved

aloft in a similar way, and, when I left, both flippers were in sight in the midst of the struggling mass.

On one occasion, when the raft was in imminent danger of being dashed on the rocks, a few of the sea-lions swam away a short distance but at once returned, and it appeared as if by concerted effort the raft was pushed away. Be that as it may, it was apparent that during most of my watch the animals floated about at the mercy of the waves.

Two days later, with Dr. Walter K. Fisher, I saw a similar but smaller raft of sea lions at Point Lobos. Doctor Fisher thought there might have been eight females and one male in this group. In my notes I have entered these rafts as "sea-going, sea-lion harems."—CHARLES W. TOWNSEND, *Boston, Massachusetts.*

SECOND OCCURRENCE OF THE PRIBILOF FUR SEAL ON THE OREGON COAST

In the JOURNAL OF MAMMALOGY (vol. 2, no. 4, p. 235), I recorded the only authentic occurrence of *Callorhinus alascanus* on the Oregon coast. As records of the Pribilof fur seal coming inshore anywhere on the Pacific coast of America are rare (California Fish and Game, vol. 8, no. 3, pp. 155–156), it is of especial interest that on or about February 28, 1925, Mr. Orie Mapes, a crab fisherman of Tillamook Bay, Oregon, captured an immature specimen in the bay near Bay City. Mr. Mapes thought it was a young harbor seal until a resident of that section advised him to send the skin to me for identification. This he did, with the result that we have the second authentic record of this marine mammal for Oregon.—STANLEY G. JEWETT, *Portland, Oregon.*

STORING HABITS OF MICROTUS TOWNSENDII

Recent investigations dealing with depredations of the Townsend meadow mouse (*Microtus townsendii*) in lowland meadows near Olympia, Washington, revealed some interesting data on the food habits of this species. Numerous caches of small bulbous roots, identified as one of the mints (*Mentha canadensis*), were uncovered under leaves and dead grass in shallow runways. As much as 14 quarts or more of these roots were found in single caches. Small logs and limbs, when lifted, displayed stores spread out two or three feet conforming to the forked position of the runways. No special pits seemed to have been prepared for the caches. Within an area of four hundred square feet, fifteen stores were unearthed on January 24, 1924. A few weeks later the caches had either been removed or eaten, as less than a handful remained in the entire plot when visited on March 17. Three specimens of *Microtus townsendii* were taken in surface runs, bordering on a drainage ditch nearby.

The bulbs composing the stores were almost entirely of the mint. They were uniform in size, white in color, and in taste and brittleness resembled the icicle radish. When transplanted vigorous growth resulted in a few weeks time.

While there is an abundant supply of green, succulent food available during the winter months in western Washington, yet this large species of the *Microtus* group seems to prefer making stores and feeding from them to foraging for his nightly subsistence. There is evidence, however, that regular visits were made to a near-by cat-tail swamp. Excavations were noticed around the base of the cat-tail stalks, where evidently the tender part of the plant was eaten. Bits of stems

and tender blades of grass were everywhere plainly seen in the network of surface runways.

According to Dr. E. W. Nelson, chief of the Biological Survey, the storing habit of the tundra vole (*Microtus operarius*) is quite common in western Alaska. Pine mice (*Pitymys*) in the eastern United States make caches of tender roots, sprouts, and small bulbs of various plants for winter use, sometimes extending 18 inches below the surface of the ground. It is believed that the storing habit of *Microtus townsendii* has not been heretofore recorded.—Leo K. Couch, *Olympia, Washington.*

THE SINGING OF THE HOUSE MOUSE

A few weeks ago Dr. H. A. Morgan reported a very interesting observation made by him and his family on the singing of a house mouse. The mouse was given to me the day after the observation but died the following day from injuries received during its capture. The specimen was identified by Dr. L. R. Dice as *Mus musculus musculus*. The observation I believe will be of interest to the readers of the Journal of Mammalogy.

The following are the notes as given by Doctor Morgan: "We had heard this mouse for three or four nights and thought for awhile the noise was made by the radiator valve which had been interrupted by bubbles of water, but a closer examination revealed the fact that it was not the radiator and was coming from another point of the room, the mouse finally being located in a waste paper basket. On shaking the basket the mouse ran out and wherever it went this singing continued. It was finally driven into a small room where it had no chance of escaping and I made the following observation: The singing continued every time it came to rest, the mouse sitting slightly upright. The sound approximated the chirp of a cricket but much more continuous. For ten or fifteen minutes before the mouse was captured it was in open space and under constant observation. The remarkable thing about it was that every time it came to rest this singing would take place, even under the excitement of the chase, so that we have the two conditions,—one in the quiet of the waste basket and the other under excitement." —Edwin B. Powers, *University of Tennessee, Knoxville, Tennessee.*

THE PIKA AT SEA LEVEL

Long known as dwellers in the high places and suspected of enjoying life only in the most rarified atmosphere close to the permanent snows, conies have recently been found living very close to sea level, along the Columbia River, not more than 30 miles from Portland, Oregon.

For several years an enthusiastic mountain climber and amateur naturalist, Mr. John Lee, had been telling of seeing conies among the rocks along the Columbia River before the highway was built. Mr. Lee's findings were not verified, however, until July 15, 1920, when Mrs. Horsfall and myself started up the Larch Mountain trail at Multnomah Falls, intent on reaching the summit, 5000 feet above. About 200 feet up, we stopped to ease our backs of the heavy packs and almost at once our ears caught the unmistakable nasal "eek" of a cony. Soon we discovered the animal running about over the moss-covered rock slide. In this particular spot not a rock was bare, all were covered with moss or grasses,—a very

unusual place for conies. From there on we saw or heard the little animals in every rock slide on the trail.

Two days later we again encountered conies on the Eagle Creek trail at a lower altitude, probably not more than 100 feet above sea level. In places they may dwell lower than where we saw them, as the slides extend down to the river.

The Columbia River Mountains are foothills of Mount Hood, so, although these conies are small and dark colored, I suppose they belong to the species found on the mountain itself, namely *Ochotona princeps brunnescens*.—R. BRUCE HORSFALL, *Washington, D. C.*

WINTER MOVEMENTS OF THE CONY

Near Golden Gate in the Yellowstone National Park there is a colony of conies *Ochotona princeps* in some slide rock on a slope facing southeast. Not only does this slope receive the full force of the sun's rays, which thereby melt the winter snows within a short time after they fall, but there is a prevailing southwest wind that usually sweeps loose snow away. Hence many of the rocks of this slide are bare most of the time even during severe weather. Wherever the conies can reach these bare spots and sun themselves in a warm nook sheltered from the wind, they do so throughout the winter. I have seen them out repeatedly on mild winter days and on February 7, 1921, they were out on a bright, sunny morning when the temperature was actually far below zero Fahrenheit. Although feet of conies are well protected, they do not seem to like to cross snow. Nevertheless I have seen their footprints crossing light snow to the sunning places mentioned above.—M. P. SKINNER, *Yellowstone Park, Wyoming.*

A LIVE-TRAP FOR SMALL MAMMALS

I have found a very satisfactory trap for small mammals up to the size of a squirrel. This is the Spring Floor Rat Trap, made by the Spring Floor Trap and Manufacturing Company of Chicago, Illinois, and now for sale at 75 cents each by a large Chicago mail-order house. This trap is made entirely of galvanized metal and screen and operates by the weight of the animal. The weight necessary to spring it can be delicately regulated even to the weight of a mouse.—L. R. DICE, *University of Michigan, Ann Arbor, Michigan.*

OBITUARY NOTICES

ERNEST HAROLD BAYNES

Ernest Harold Baynes, who died January 21, 1925, at Meriden, New Hampshire, will long stand as a unique figure, known throughout the United States and in Europe as an ardent lover of all wild life and an effective leader in various successful undertakings for its preservation. Twenty-five years ago when the American bison was in danger of completely dying out, it was largely through his energy that the American Bison Society was organized, funds secured, and practical methods adopted for forming herds of sufficient size and in suitable localities to ensure the preservation of this magnificent creature. Through his lectures and writings Baynes became a leader in arousing a wide popular interest in birds and in the formation of bird-sanctuaries. He was passionately fond of pets, and had many unusual experiences in taming wild animals,—weasel, skunk, fox, coyote, and various birds. Of some of these he has published a brief account in book form,—"Sprite,the Fox", "Polaris, the story of an Eskimo dog", "Jimmie, the story of a Black Bear cub." During the World War, he visited various fronts under the auspices of the Blue Cross Society and other organizations, in a study of the part played by animals, particularly by domestic mammals, in the great conflict. The material so gathered he had planned to assemble into another book, which, however, his untimely death found but half completed. Among his many shorter contributions to popular magazines there are items and illustrations of permanent value. He was one of the first to describe the peculiar drumming habit of the white-footed mouse (*Peromyscus*). At the time of his death he was actively engaged in a campaign of education as to the value of medical discoveries made through research upon animals with a view to the alleviation of human ills. From personal observations in many laboratories, he was able to show not only that the old-time cruder methods of experimentation with animals are no longer in vogue but that modern work under humane conditions has resulted in extraordinary benefits to humanity.

Baynes was born in Calcutta, India, May 1, 1868, soon thereafter coming to New York where he received his education. After leaving the College of the City of New York, he served for a while on the New York *Times*, and later worked with his father on photographic modelling. In 1901, he actively took up what was to be his life work of writing and lecturing on natural history. It was at this time that he married Louise Birt O'Connell of Boston, and moved to Meriden, New Hampshire, the better to enjoy the out-of-door life in which both delighted. Of a modest and unassuming personality, his nature was none the less forceful, sincere and courageous. His work, though unfinished, cannot but have a lasting influence for human advancement.—GLOVER M. ALLEN, *Museum of Comparative Zoology, Cambridge, Mass.*

CHARLES BINGHAM PENROSE

It is with profound regret that I write of the death of Dr. Charles B. Penrose, which occurred on board a train en route from Aiken, S. C., to Philadelphia on February 27, 1925, early in his sixty-fourth year. Doctor Penrose held a very high reputation as a surgeon, was a zoologist of considerable note and an acknowl-

edged leader in game conservation. He was elected a life member of the Zoological Society of Philadelphia on April 25, 1901, and to the Board of Directors of the society on January 9, 1902; he was made a member of the Executive Committee on October 9, 1902, and made president of the society on April 22, 1909, which position he retained until his death.

Upon becoming president, he took a very active part in the management of the Zoological Garden and even after he had given up many of his vast interests on account of ill health, he retained his interest in the garden and was a frequent visitor, watching and directing with keen interest every detail of the work. He was instrumental in founding the Pathological Laboratory, which was opened for work on February 11, 1905. This is practically the only laboratory of its kind in the world, and much important scientific work has been accomplished here due principally to his efforts and interest.

Doctor Penrose was for many years the president of the Pennsylvania Fish and Game Commission, and much of the credit is due to him for the effective game laws now in force, and which such great game conservationists as Dr. Wm. T. Hornaday state are in a class by themselves.

I have been in close personal contact with Doctor Penrose for the past eight years and have found him a very retiring man, never seeking notoriety but going deeply into scientific studies solely for the love of the work.

In September, 1907, while on a hunting trip in Montana, Doctor Penrose was attacked by a huge grizzly bear and very badly injured. It seemed that he left camp with a guide at about four o'clock in the afternoon to hunt deer. About two miles from camp they tied their horses and set out on foot in different directions. Doctor Penrose came suddenly upon a cub bear which was coming directly toward him and which was only about 75 yards away. He shot the cub and walked over to it, placing his rifle against a tree; then started to take out his knife with the intention of skinning the cub, when suddenly two large grizzlies appeared. The larger of the two, probably the mother of the cub, growled and came at Doctor Penrose. He reached for his gun and was able to fire two shots before she reached him. He noted in his account of the attack that she did not rear up or strike with her paws, but seized him as a dog would, burying her teeth deeply in the muscles of his left thigh; as he himself stated, she shook him as a terrior would a rat. She then seized and crushed his left wrist and bit him on the breast. Then she stopped and stood over him growling while he lay still, but the moment he made a move to reach his gun, she started chewing the right side of his face and neck. As soon as she stopped, the Doctor, who was pretty well used up, lay perfectly still. This seemed to satisfy her, as after standing over him a few seconds she walked across the creek and fell dying on the opposite bank about twenty yards away, having been mortally wounded by one of his shots. Doctor Penrose's own interesting account of this experience has just recently been published in a book of the Boone and Crockett Club. Doctor Penrose was a brother of the late Senator Boies Penrose, who also was an enthusiastic hunter of big game.

With the passing of Doctor Penrose, the Philadelphia Zoological Garden loses an active and practical zoologist whom it will in my opinion never be able wholly to replace. The following telegram which was received from the New York Zoological Society shows to some extent the high esteem in which Dr. Penrose

was held by men most prominent in zoological circles: "The New York Zoological Society deeply regrets the loss to your society, zoology, science and to the world of Dr. Charles B. Penrose, your illustrious president. His influence in the field of zoological education was important. He was a great pioneer and leader in game conservation, and his passing is a great loss to both those causes."—C. EMERSON BROWN, *Zoological Society of Philadelphia, Philadelphia, Pa.*

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SEVENTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF MAMMALOGISTS

[*Plate 18*]

The seventh annual meeting of the American Society of Mammalogists was held in the U. S. National Museum, Washington, D. C., from April 7 to 11, 1925, with 79 members in attendance. This is the largest, and by inference the most successful, meeting in the history of the Society.

Most of the 31 papers presented were of a noteworthy order of excellence and many were followed by lively and interesting discussion. The latter is often more instructive than the paper which prompts it, and it is hoped that future programs may be arranged so as to give more time to this feature. Those items of the meeting that held a popular appeal attracted many visitors, and the four numbers illustrated by motion pictures proved extremely interesting and called forth much favorable comment.

PROGRAM

Tuesday, April 7

8:00 p.m.

1. Asymmetry of the skull in mammals. A. Brazier Howell. Slides.
2. A new protypothere from the Santa Cruz formation of Patagonia. H. H. Lane. Specimen.
3. Changes in the relations of certain bones in the cetacean skull and their bearing upon the sense of smell. Remington Kellogg. Slides.
4. The new fossil mammal faunas from Mongolia, with suggestions as to their bearing on certain problems of zoogeography. W. D. Matthew. Diagrams and drawings.
5. Classification of the North American Sciuridæ. Arthur H. Howell. Slides.
6. The Pleistocene Mammalia preserved in the ash-beds of Punin, Ecuador. H. E. Anthony. Slides.

2:30 p.m.

7. A statistical summary of the Mammalia of the Antilles. H. E. Anthony.
8. Convergence in Chilean mammals. W. H. Osgood. Specimens.
9. The wood buffalo situation. Francis Harper. Slides.

3:30 p.m.

Annual business meeting.

8:15 p.m.

10. On Darwin's trail in South America. W. H. Osgood. An illustrated lecture.

Thursday, April 9

9:30 a.m.

11. Menace of the dog. E. T. Seton.
12. Observations on the Hawaiian seal. A. Wetmore. Slides.
13. Laboratory methods in the study of animal behavior. Curt P. Richter. Slides.
14. Surplus game,—a problem in administration: with special reference to Kaibab deer. E. A. Goldman. Slides and motion pictures.

15. Mammal life of the Carlsbad Caves, New Mexico. Vernon Bailey. Slides and motion pictures.

2:30 p.m.

16. Habitat relationships of the mammals of the Okefinokee Swamp region. Francis Harper. Slides.
17. Vanishing game trails of Africa. William P. Harris, Jr. Motion pictures.
18. (*a*) The wood buffalo. (*b*) Monarchs of the plains. R. M. Anderson. Motion pictures.

FRIDAY, APRIL 10

9:30 a.m.

19. Trapping laws and the fur supply. Frank G. Ashbrook.
20. The pika at sea level. R. Bruce Horsfall. Slides.
21. Migration routes of elk in Yellowstone National Park. M. P. Skinner. (By title.)
22. Studies on the variability of primates. Adolph H. Schultz. Slides.
23. A trip in quest of the Santa Rosa Island beach mouse and some of its allies. F. B. Sumner. Slides.
24. Notes on some new mammals from the Philippines. E. H. Taylor. (Presented by H. H. Lane.)
25. New methods in mammal taxidermy. W. H. Osgood. Specimens.
26. What measurements of mammals should be taken in the field? American versus Old World practice. H. E. Anthony.

2:30 p.m.

Symposium: The care of mammal material and records.

27. The care of museum specimens of recent mammals. Hartley H. T. Jackson.
28. The care of anatomical and embryological material. Adolph H. Schultz.
29. The care of fossil mammals. W. D. Matthew.
30. Facts and figures on live animals in captivity. John T. Benson.
31. The care of pamphlets, photographs and reports. Lee R. Dice. (By title.)

4:30 p.m.

Final business session.

SATURDAY, APRIL 11

9:00 a.m.

Members assembled at the Hotel Harrington and were escorted to the National Zoological Park, where they spent the morning under the guidance of the Superintendent, Dr. Alexander Wetmore. At 1:00 p.m., the members and their wives were entertained at luncheon, as guests of the Administration of the Park and the Washington members, at the Administration Building of the National Zoological Park.

An enjoyable feature of the meeting was the dinner April 9, where the members were entertained by a few well chosen speakers who held forth in lighter vein. The main item upon the menu was roast buffalo, while elk meat figured at the luncheon, April 11.

At the directors meeting, Dr. Hartley H. T. Jackson was chosen as editor of the Journal, and, in business session, officers of the Society were elected as shown on the second cover page of this issue. Doctors Jackson and Lane were appointed

to represent the Society in the council of the American Association for the Advancement of Science. It was decided that the next meeting shall be held during April, 1926, at the American Museum of Natural History in New York City.

The sixth annual report of the Corresponding Secretary was as follows:

Names of new members acted upon April 8, 1925	62
Members elected by Directors October 30, 1924	21
Reinstated	1
Subscribers added since April 16, 1924	17
Total members and subscribers added since April 16, 1924	101
Members, April 16, 1924	646
Honorary member, April 16, 1924	1
Subscribers, April 16, 1924	99
Members delinquent 1923 dues, April 16, 1924 (not receiving vol. 5)	34
Members with lost addresses, April 16, 1924	6
Distribution of JOURNAL April 16, 1924	712
Members lost by death since April 16, 1924[1]	4
Resignations since April 16, 1924	9
Dropped for address unknown, April 8, 1925[2]	4
JOURNAL cancelled for address unknown[2]	3
Subscriptions cancelled since April 16, 1924	14
Dropped for delinquency April 8, 1925	13
Members April 8, 1925	700
Members delinquent 1924 dues of April 8, 1925 (not receiving vol. 6)	28
Members receiving JOURNAL April 8, 1925	656
Subscribers April 8, 1925	102
Distribution of JOURNAL April 8, 1925	758
Net increase in distribution of JOURNAL since April 16, 1924	46

The following have taken out life membership since the last annual meeting: W. B. Cadwalader; Victor J. Evans; William P. Harris, Jr.; and Bradshaw H. Swales.

Resolutions were passed expressing the appreciation of the Society for the courtesies and hospitality extended by the administrations of the U. S. National Museum and National Zoological Park, and one of sympathy and regret concerning the enforced absence from the meeting of Dr. E. W. Nelson through illness. The following resolution was also adopted:

WHEREAS: plans have been made for introducing large numbers of Plains Buffaloes annually into the Wood Buffalo Park of northern Alberta, and whereas the American Society of Mammalogists, a professional Society of *international* membership, including practically all field naturalists who are interested in mammals, feels that serious results would occur from carrying out the above mentioned plan; viz.:

A. Interbreeding would take place between the races of the Plains Buffalo and Wood Buffalo so that the distinctive characteristics of the Wood Buffalo would be

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[1] Clinton L. Bagg; Ernest Harold Baynes; Ned Hollister; Chas. B. Penrose.

[2] E. T. Blundell; Ralph E. Butler; W. N. Martin; R. H. Palmer.

[3] Kellogg F. Bascom; Alta H. Haynes; C. F. Hedges.

lost in a few generations and in this way the largest and noblest game animal of North American would pass out of existence as such.

B. The new arrivals and mixed descendents of the two races of buffaloes would be less fitted to carry on the struggle for existence in northern Alberta than is the native race of Wood Buffalo.

C. Tuberculosis and other diseases would be likely to be transmitted with harmful effects to the northern herd.

D. Owing to the restricted range of the Wood Buffaloes and the limited amount of food available, overcrowding would follow so that the proposed plan would afford only a temporary means of disposing of Plains Buffaloes: therefore be it

Resolved: that the American Society of Mammalogists express its earnest hope that some other means may be found of disposing of the surplus Plains Buffaloes; and be it further

Resolved: that copies of this resolution be forwarded to the Department of the Interior of Canada and to the organizations interested in wild-life conservation.[4]

—A. Brazier Howell,
Corresponding Secretary.

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[4] Twelve copies of this resolution have been forwarded to departments and organizations most concerned with such matters.

MEMBERS AT THE SEVENTH ANNUAL MEETING

1, C. H. M. Barrett; 2, R. Kellogg; 3, F. C. Kirkwood; 4, H. H. Shamel; 5, A. H. Howell; 6, C. W. Richmond; 7, A. Wetmore; 8, C. R. Shoemaker; 9, J. H. Riley; 10, E. A. Preble; 11, E. A. Goldman; 12, F. C. Lincoln; 13, Mrs. W. Stone; 14, Mrs. H. H. T. Jackson; 15, Mrs. E. E. Snyder; 16, Mrs. T. S. Palmer; 17, B. H. Swales; 18, G. Marshall; 19, Mrs. F. Harper; 20, Miss E. M. Charters; 21, H. H. T. Jackson; 22, Mrs. J. S. Elliott; 23, T. S. Palmer; 24, C. H. Merriam; 25, F. Harper; 26, W. H. Cheesman; 27, W. Stone; 28, E. T. Seton; 29, J. Silver; 30, W. L. Brown; 31, M. W. Lyon, Jr.; 32, W. H. Osgood; 33, M. A. Stewart; 34, F. B. Sumner; 35, A. K. Fisher; 36, W. D. Matthew; 37, R. M. Anderson; 38, A. B. Howell; 39, F. G. Ashbrook; 40, W. L. Schmitt; 41, H. E. Anthony; 42, J. W. Gidley; 43, A. H. Schultz; 44, C. C. Adams; 45, H. H. Lane; 46, J. H. Fleming; 47, W. L. Straus; 48, R. H. Santens; 49, C. R. Aschemeier; 50, J. T. Penson; 51, Mrs. V. Bailey; 52, W. C. Henderson; 53, W. P. Harris, Jr.; 54, V. Bailey; 55, A. J. Poole; 56, R. B. Horsfall.